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THE TERMINAL FACILITIES OF A GREAT RAILWAY.

THE Philadelphia *Public Ledger* has obtained from the general manager of the Pennsylvania Railroad the following statement of the terminal facilities of that road at New York, Philadelphia, and Baltimore, and the additions made thereto during the past year.

In the development of their property in New York harbor (118 acres on the Jersey City side, with a water front on the Hudson River of 3,460 feet) the company have constructed during the past year three large steamship piers, with a storage area under cover of 450,000 square feet (over ten acres), capable of holding (and still leaving working room) from 15,000 to 20,000 tons of merchandise freight, with berth room (4,000 feet) for eight of the largest ocean steamships. In addition to this they have erected a grain elevator with a storage capacity of 1,500,000 bushels, and so arranged that by means of conveying belts grain can be delivered to four steamships at one time (they being berthed alongside two of the above mentioned piers), and at the same time receive or discharge their merchandise freight. Besides this, an open pier, capable of accommodating six sailing vessels at one time, has been constructed so as to be specially adapted for the purpose of receiving foreign ore, which is transferred directly from the vessels into the cars and sent West to the various iron furnaces located in the interior. Large as the above figures may seem, they cannot convey an adequate idea of the total amount of work done, as the construction of bulkheads, filling in, the building of tracks, dredging, etc., have been a very heavy and expensive task. It must also be borne in mind that in addition to the facilities described as constructed during the past year, this company already had berth room and storage warehouses necessary for the accommodation of four steamships in the direct export trade, besides extensive passenger and freight stations, stock yards, ferries, abattoirs, etc., necessary to handle a daily business of 1,200 freight cars, and there is now under contemplation the erection of further facilities, which, when completed, will give still greater export advantages.

The Pennsylvania Railroad at its terminus at Baltimore had, last year, three elevators at Canton aggregating 1,275,000 bushels capacity; a steamship pier covering 35,000 square feet; a tobacco warehouse of 2,500 hhds. capacity; and a coal pier of 1,000 tons capacity. It also had at Brown's wharf a coffee warehouse of 50,000 bags capacity, and at Jackson's wharf a warehouse for storing and polishing coffee; another warehouse 55 feet square, and two piers covering 24,220 square feet. The aggregate capacity for handling freight at Baltimore last year was 625 cars daily. To this has been added for this season a large, new steamship pier at Canton covering 24,000 square feet, which, with the track room and other adjuncts, has increased the daily capacity for handling freight by 700 to 800 tons.

The Pennsylvania Railroad at Philadelphia last year had 455 acres of storage yards adjacent to export piers, there being 41 acres at Hamburg for oil shipment, 100 acres at Girard Point for grain and general merchandise, 256 acres at Greenwich Point for coal, and 29 acres at the Old Navy Yard and Reed Street wharf for general merchandise. There were at these various points track room sufficient to accommodate 3,321 cars, while the piers to which they led had 15,055 lineal feet of accommodation for vessels on berth, and tracks sufficient to accommodate 694 cars in loading and unloading cargo from vessels. There were also three elevators at Girard Point and Washington Street wharf, covering altogether about 3½ acres of land. For the business of 1880 the following increased accommodations are added: Track room for 575 cars has been added at Greenwich, and 280 cars at the old Navy Yard, a total of 855 cars, increasing the track capacity to 4,170 cars. The lineal feet of berth room for vessels has been increased by 1,200 feet at Greenwich and 1,920 feet at the old Navy Yard, a total of 3,120 feet, bringing the aggregate up to 21,175 feet. The track capacity on the piers has been increased 130 cars at Greenwich and 70 cars at the old Navy Yard, a total of 200 cars, bringing the aggregate capacity up to 894 cars. In 1879 the daily maximum capacity for handling freight at Philadelphia was 1,990 cars, and the daily average was 1,192 cars handled. This for 1880 is increased to 2,155 cars daily maximum capacity, and 1,380 cars the daily average handled. This is an increase of 165 cars maximum capacity, and of 188 cars handled daily. There has besides been an increase of about 100 cars daily capacity in handling grain by introducing a series of portable chutes connected with the coal piers at Greenwich, and this, aided by the electric light at night, can be increased in capacity about 70 cars more. The introduction of the electric light will also increase the handling capacity of coal over the Greenwich piers by 100 to 120 cars per day.

FISHER'S STAMPING MILL.

WE illustrate below a very ingenious form of stamping mill, designed by Mr. John Fisher, of 43 Mincing Lane, London. The arrangement is so simple as to require little explanation. From the drawings it will be seen that the machine is made with a heavy baseplate and framing; above

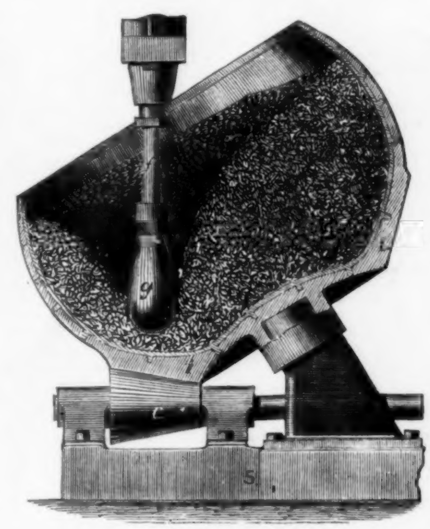


FIG. 2.

the former in suitable bearings runs a horizontal shaft, on which is a conical roller; motion is given to this shaft by a wormwheel and worm, the latter driven by a small oscillating cylinder attached to the frame. To the baseplate is bolted a foundation for the pan containing the materials to be crushed; this pan is mounted on an inclined axis, and is caused to revolve by the conical wheel on which the pan rests, the underside being so shaped as to form a line of contact with the roller for the whole of its circumference. To the top of the pan is bolted a cylindrical screen of any desired mesh through which the stamped material can be discharged, or it may if desired find an exit through the pipe in the center of the pan. The hammer is of steel and of the form shown, with a chilled cast-iron head. On the rod of the hammer is a piston working in a vertical cylinder, and a stem extends above through the top of the cylinder, terminating in a nut working on a rifled bar, so that the hammer may be caused to partially revolve at each down stroke, such movement being prevented on the up stroke by a ratchet wheel and pawl shown in the drawing. The handwheel at the side of the cylinder is employed to regulate the stroke of the hammer to adapt it to the material being treated. The hammer is worked at a high velocity, varying from four hundred to eight hundred strokes per minute. The second illustration shows a modification of the same machine especially adapted for husking paddy and cleaning rice and other grain. As will be seen the general arrangement is the same, but the pan is of a different form, and is lined with cement or other suitable material, the stamp head being also cased with cement. The combined stamping and rubbing action caused by the hammer and the revolution of the pan, husks and cleans the grain in a remarkably efficient manner, and in a very short time, the turn out being about twelve hundredweight an hour. It may be mentioned that this machine embodies in a mechanical form the process of cleaning rice in use in China since time immemorial.—*Engineer*.

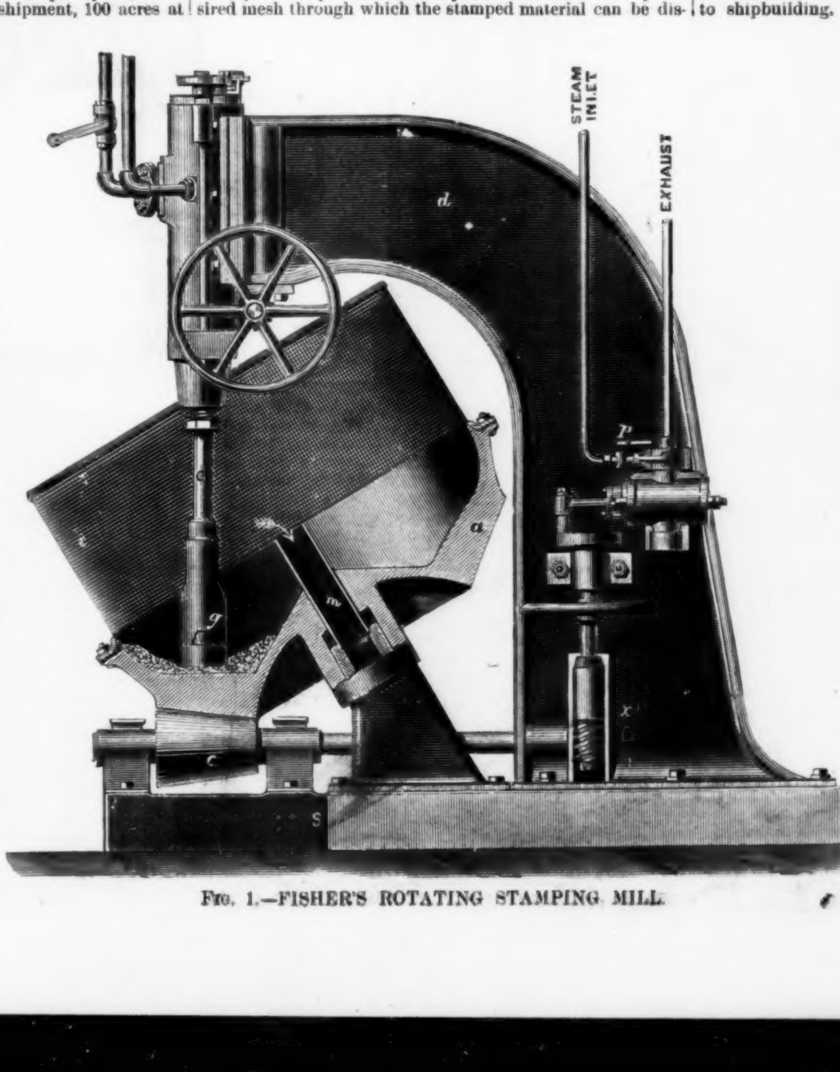


FIG. 1.—FISHER'S ROTATING STAMPING MILL.

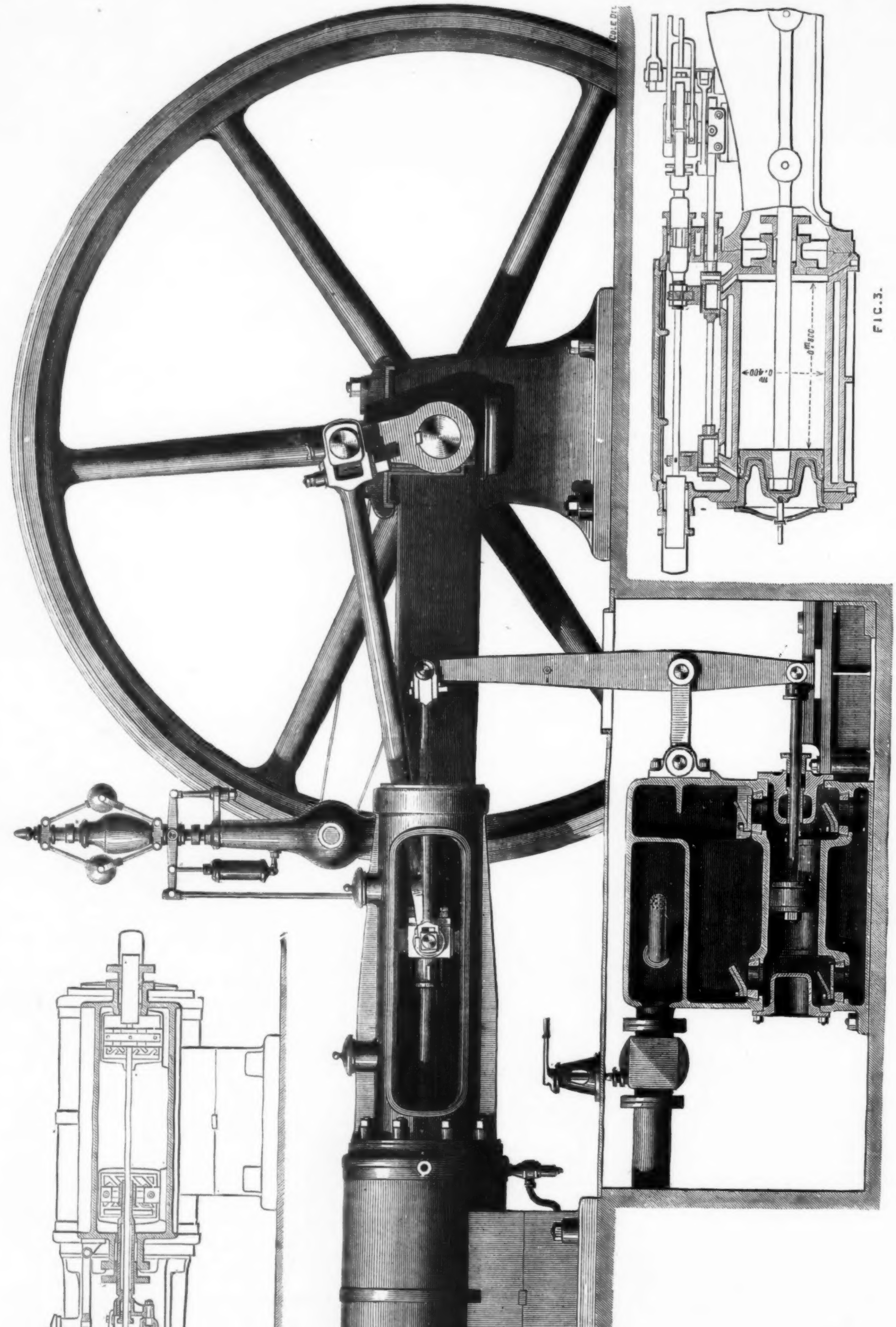
STEEL STEAMSHIPS OF THE FUTURE.

ONE at least (the Aurania) of the new Cunarders will be built of steel. As iron succeeded wood in the construction of ocean steamships, so steel, it is predicted, is about to replace iron. The introduction of steel for this purpose is England's last and longest stride ahead for the supremacy of the seas. The experiments which have finally led to the adoption of steel in shipbuilding have been tedious and costly in their repeated failures, but have resulted at last in a great success. Only three or four years ago the British steel manufacturers were on the point of abandoning in despair their expensive efforts in this line. Some of them had felt so confident of their triumph over all obstacles in the attempt that they took contracts for supplying steel plates to the Admiralty. In every instance these proved worthless. Few of the plates could stand any of the requisite tests. Those which had passed inspection and were riveted to the hulls of vessels cracked in an inexplicable manner. Seams would open up the whole length of the plate. The Admiralty were compelled to reject the novelty from which so much had been hoped. But still the steel manufacturers were not wholly discouraged. They called new chemists and metallurgists to their aid, and sank still larger sums in more experiments. Finally they have come out victorious. They are now making steel plates which will endure a tensile strain of from twenty-six to thirty tons per inch, and the ductility of which satisfies all the bending and punching tests rigidly prescribed by the Admiralty. There has been for some time no question of the entire adaptability of steel to shipbuilding. It is now considered the most perfect material for that class of work, as well as the cheapest in the long run. If so, it is surely destined to make a revolution in the ocean marine and in the war fleets of the world.

The prime cost of steel shipbuilding plates is not mentioned in English journals. But it is probably not greater than that of the Bessemer steel rails which are now replacing iron on railroads everywhere. The steel rails cost more than iron, but they are far more durable than the latter, and much more economical in use. The same good-wearing properties may be expected of steel in ships. A great saving will at once be effected in the weight of hulls. It is found that the weight of a steel hull is less by one hundred and fifty or two hundred tons per thousand tons than that of an iron hull of less strength. The steel ship can therefore carry more freight proportionately to her size than her iron competitor. This will make a material difference in the profits of voyages when it is a permanent advantage enjoyed by the steel ships. But it is said that this is not the best of the change. The steel ship is believed to be safer in case of stranding or striking concealed rocks. The owner of a river line in which steel ships have been lately introduced reports that one of these vessels struck a snag and came off safe and sound, her hull being indented but uninjured. In the event of a collision between a steel ship and one made of any other material, the former would doubtless inflict more damage than it would receive. The most formidable naval rams are those made of steel. For these reasons we are not surprised to hear from British sources that "ships of the largest class and subject to the strain of the most powerful steam

HORIZONTAL CONDENSING ENGINE AT THE BRUSSELS EXHIBITION.

LA SOCIETE ANONYME DE MARCINELLE ET COUILLET, ENGINEERS.



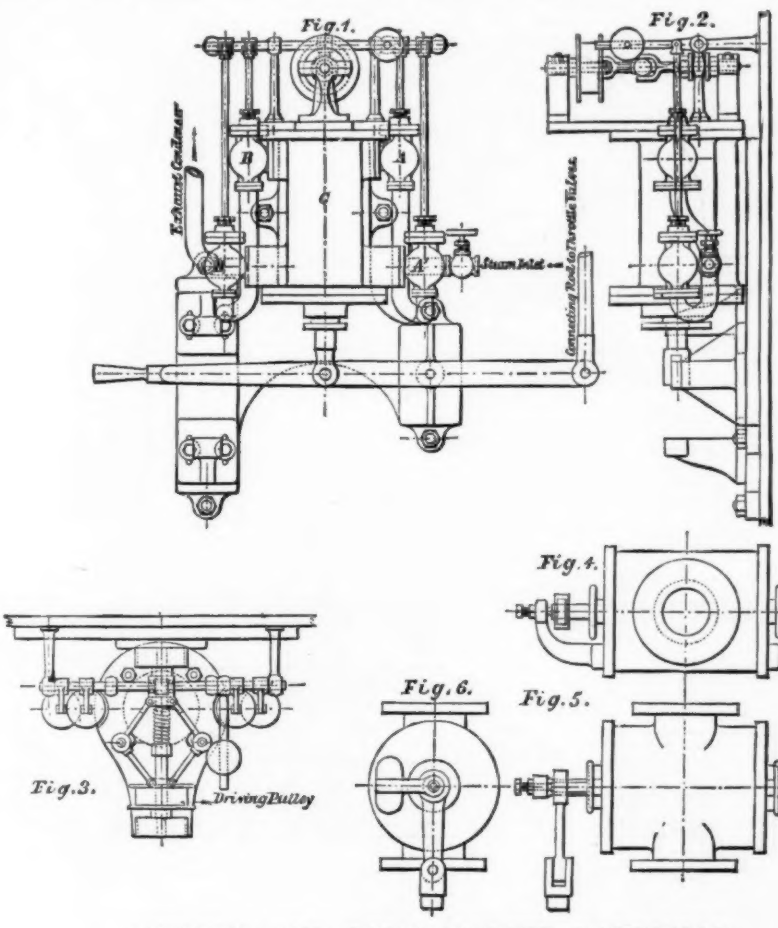
machinery in the world are now being constructed of steel both for the royal and for the mercantile marines of this (England) and other countries."—*N. Y. Journal of Commerce.*

JENKINS AND LEE'S MARINE GOVERNOR.

WE give engravings of Jenkins and Lee's marine governor, now being made by Messrs. J. H. Wilson & Co., of Liverpool, this governor being arranged to control both cylinders of compound engines. In our engravings, Fig. 1 is a front elevation of the governor, Fig. 2 a side elevation, and Fig. 3 a plan, while Fig. 4 contains views of a valve for the low-pressure cylinder to which reference will be made presently.

In Figs. 1, 2, and 3, C is a steam cylinder fitted with the steam inlet valves, A, A¹, and the exhaust valves, B, B¹. The four valves A, A¹, B, B¹, are all operated simultaneously by the centrifugal governor shown, the arrangement being such that when the steam valve for the top and the exhaust valve for the bottom of the cylinder, C, are closed the opposite pair are opened, and *vice versa*, the piston in the cylinder, C, moving down or up according to whether steam is admitted to the top or bottom of the cylinder. To the piston working in the cylinder, C, is connected a lever which actuates a throttle valve controlling the admission of steam to the high-pressure cylinder.

To control the low-pressure cylinder there is provided the valve shown by Fig. 4, this valve being placed midway between the ends of the low-pressure cylinder, to both of which ends it is connected. The valve is—like the ordinary throttle valve—coupled to the piston working in the cylinder, C, the arrangement being such that when the steam is cut off from the high-pressure cylinder, the valve shown by



JENKINS AND LEE'S MARINE GOVERNOR.

Fig. 4 is opened and the two ends of the low-pressure cylinder are thus placed in free communication, thus placing the low pressure cylinder in equilibrium. The governor we have been describing has been already fitted to six sloops in the United States Navy, while we have also received a list of seventeen other screw steamers to which it has been applied, with, it is stated, very satisfactory results.—*Engineering.*

HORIZONTAL ENGINE, BRUSSELS EXHIBITION.

WE illustrate opposite a horizontal condensing engine at the Brussels Exhibition, exhibited by the Société Anonyme de Marcinelle et Couillet, a Belgian company of high reputation. The engine has a cylinder 15¾ inches diameter and 2 foot 7½ inch stroke. The crank shaft bearings are 7 inches in diameter. The flywheel, the edge of which is turned to take a belt, is 11 feet 6 inches diameter. The air-pump piston is 7⅞ inches diameter and 15¾ inch stroke. Fig. 1 is an elevation; Fig. 2 a plan; and Fig 3 an enlarged view of the valve gear, which is of the trip type, secondary slides on the back of the main slide serving to cut off the steam. The rod of the hindermost slide works through the rod of the leading slide, which is tubular; each rod is fitted with a plunger or enlargement, and the pressure of the steam in the valve chest acting on these enlargements tends always to move the cut-off slides and make them close the steam admission ports. The eccentric rod works a sliding block which carries two horned drivers, or pushing pieces, these catch alternately on steel plates secured to the cut-off valve rod, and as the block under the influence of the eccentric moves right and left, so one or other valve is pushed open, and kept open till one or other of the vertical horns comes against a stop on a bar, one end of which bar is hinged, while the other is made to rise and fall by the governor, and so in a very obvious way alters the point in the stroke at which the pushing pieces are thrown out of gear, and the cut-off valve allowed to close. This gear works very well, and the entire engine is well designed and well finished.—*The Engineer.*

BOSTON GRAIN ELEVATORS.

THERE are four elevators in Boston, the largest being the Boston and Albany elevator at the Grand Junction Wharves, East Boston. This building is 400 feet long, 75 feet wide, and 125 feet high, and has a capacity of 1,000,000 bushels. The machinery is driven by a magnificent engine of 600 horse power, and twelve cars can be drawn in at the same time, the unloading requiring from eight to twelve minutes, which includes the carrying of the grain to the top of the building, weighing it, and dropping it into the bin. This elevator contains 180 bins, each holding from 5,000 to 8,000 bushels, and it can dispose of 360 cars per day. The Shawmut elevator has a capacity of 50 cars, the Mystic wharf 100, and the Chandler street elevator, also owned by the Boston and Albany Corporation, has a capacity of 500,000 bushels, the latter building being used exclusively for the local business.

STOVE FOUNDRIES.

By A. J. WATERS.

LIKE a rolling mill, the principal point of hazard in a stove foundry is the roof; an imperfectly-constructed cupola, a low building, and a wood roof is a hazardous risk; while a modern cupola, high brick building, and iron roof invites not a whit more hazard than a dwelling house.

The average height of a cupola at a stove foundry is thirty feet and four feet in diameter. It is made of boiler iron three-sixteenths to one-quarter of an inch thick. Such a cupola new is worth about $500. The actual wear is but nominal. The repairs consist in lining the lower part with fire brick. Generally the burning of the foundry does not injure the cupola. The machinery of a foundry is somewhat limited; one or two lines of shafts, pulleys, and belts, with cleaning mills, emery wheels, and polishing machines, comprise about all. A *cleaning mill*, for removing the sand from the castings, is worth from $35 to $40, will depreciate fifteen per cent. a year, and loses its value after a fire. An *emery machine*, without the emery wheel, is worth about $65. The emery wheels will cost for every inch in diameter nearly $1, and, in constant use, will wear out in ninety days. The balance of the machine will depreciate ten per cent. a year, and after a fire can be weighed up as old iron. A polishing machine varies in cost from $100 to $500, an average price would be about $150. This does not include the emery wheel. A fair depreciation is fifteen per cent. a year, and a fire eliminates its value, save what the "scrap" would bring.

One of the great expenses in a foundry is that of patterns. A cook stove pattern is worth from $100 to $500; as these are made of iron, any considerable fire will warp or harden them, and render them useless. Stove patterns rarely wear out. They may meet with accidents and break, but the actual wear need scarcely be considered. Their value depends upon the sale of the stove, and the per cent. of depreciation is based upon its market value. A set of patterns from which but one lot of stoves had been made, and then thrown aside, would be nearly valueless as compared with one from which several thousand had been made. And herein is another paradox in depreciation. The more the pattern has been used the more valuable it is, as the calling for parts of stoves in repairing makes such a pattern a constant source of revenue, and the market demand for the stove determines the value at the time of the fire. *Flasks* are what the mould is made in; an average cost is $3. They will depreciate twenty per cent. per year, and, being of wood, rarely are classed under "partial losses."

Follow-boards are the part of a mould upon which the patterns rest, are worth about $5 each, and will last as long as the patterns. Should, however, the follow-board get wet so as to warp or get partly burned, there is no value left. So long as it can be used it is just as good as a new one.

THE FOURTH STATE OF MATTER.

A NUMBER of articles have already been published refuting Mr. Crookes' hypothesis, and we now notice another, by Prof. F. W. Gintl, of Germany, who has recently written a pamphlet, in which he shows that the phenomena described by Crookes may be satisfactorily explained by the mechanical theory of heat. As the attenuation of the gas which fills the tube is very great, the electrode particles that are hurled off from the pole find no resistance and fly with undiminished velocity through the space afforded them, the phosphorescence being caused by the repeated shocks to which the glass walls are subjected by these particles. Dr. Puley has demonstrated the fact that this phosphorescence can be observed only as long as the attenuation of the gas does not exceed a certain degree, and that Mr. Crookes' assertion, viz., that this phenomenon occurs at an infinite attenuation, is an incorrect one. The attenuated gas does not change its properties, which would surely be the case if a dissolution into its original atoms were to take place, as the English chemist maintains. Dr. Puley arrives at the same conclusion as Mr. Gintl, viz., that phosphorescence is caused by loosened electrode particles, which are at the same time the medium for the electric current.

A new and very interesting explanation for the phenomena observed by Crookes has been discovered by Dr. Zoch, of Sarajevo, and the following is the description which the *Chemiker Zeitung* gives of it:

Dr. Zoch maintains that the electric current is mediated, not by the electrode particles, but by the gas molecules. He bases his assertion upon investigations made by spectral analysis. The phenomenon observed in the Geissler tubes he divides into two phenomena, an optical one and a mechanical one. The optical phenomenon is caused by the gas molecules becoming heated to a glowing heat; the latter phenomenon is produced by a stratification of the attenuated gas.

In order to make the stratification more obvious to the eye, Dr. Zoch filled his tubes, which had a diameter of 10–30 cm. and 1–3 cm., with smoke, closed them with corks, and exposed them to the influence of a strong electric machine of the Winter type (this machine, as has been ascertained, produces the same effect regarding stratification as an induction current). In the smoke appeared a current having the direction from the positive toward the negative pole. At this latter point and in the middle portion of the tube there were condensed rotating parts observed, and the whole phenomenon showed that a stratification of the medium had taken place. In order to fix this stratification, Dr. Zoch filled the tube with bronze dust. As soon as the electric machine began to act the bronze particles moved from the positive toward the negative pole and became stratified, the degree and different forms of stratification depending upon the duration of the electric current, the relation of the electric tension to the resistance in the interior of the tube, the moisture of the air, etc.

If we now compare these facts with the phenomena observed in the Geissler tubes the closest analogy will at once be seen. These phenomena are also greatly influenced by the dimensions of the tubes and the conditions accompanying the electric discharge. The positive light displays to the eye a very peculiar shape; we are able to discern both light and dark strata. If we experiment with a Geissler tube for some time, and, after the current has been interrupted, touch the poles in order to draw off the electricity, we shall observe a sudden flash of light, just as though the current had passed the tube. The same treatment of the tube filled with the bronze dust produces a similar phenomenon; the dust is suddenly whirled up and the strata become somewhat displaced. The explanation of this phenomenon Dr. Zoch finds in the fact that the molecules, though not in contact with the electric poles, are electrified in the same sense with them, and they are hurled away, diverging in all directions. The glass walls are saturated with the same kind of electricity, and endeavor, although with less power, to push the bronze particles toward the axis of the tube. As the result of this counteraction, figures are formed which resemble figures of dust or snow seen in some places, and which are caused by the blowing of the wind. The walls of the tube being regular, these figures obtain a more or less regular shape; near the negative pole the strata have a convex form, the current being especially directed toward this pole. If the tension becomes too great or the current lasts too long, all the dust will finally be collected at the negative pole, and the stratification will disappear, because in this case the horizontal component is much longer than the vertical one. In tubes filled with gases this phenomenon cannot take place on account of the expansibility of the medium; nevertheless at the negative pole, where the greatest dark space is observed, the greatest quantity of gas is accumulated. When tubes open on one end are used, the bronze dust is not stratified, but the single particles are hurled out with great power.

Electricity, when suddenly discharged, chooses the shortest route; when the discharge takes place in a slow current it expands in diverging rays, which seem to be reflexible. If a small shallow dish, with the concave side turned outward, is fastened near the spark conductor of an electric machine, and a fine rain of bronze powder permitted to fall between them as soon as the machine is put into motion, the particles of the powder are hurled in a direction converging toward the center of the concave side of the small dish. This phenomenon explains the experiment which Mr. Crookes made by arming an electrode with a concave mirror.

We thus perceive that neither is the hurling of the particles, nor yet the rays, a peculiarity of the medium, and that the effect of these rays—they are able to turn a little wheel, as Mr. Crookes has shown in his experiments—is also independent of the medium, and is caused only by the electric current; therefore we have no reason to assume a fourth state of matter.

ON THE MECHANICAL TRANSMISSION OF SOUND BY WIRES.

By W. J. MILLAR, C.E., Sec. Inst. Engineers and Shipbuilders in Scotland.

THE object of the present paper is the description of a series of experiments made by the author upon the transmission of sounds by wires without the aid of electricity, and also the description of some simple forms of microphone receivers, which the author has from time to time arranged when experimenting upon electric transmission of sound.

The author's attention had for some time been drawn to the consideration of the mechanical transmission of sound through partition walls between rooms, and it appeared to him that such transmission might be possible, even although the intermediate connection was much extended.

Some experiments were made with wires, which were at first unsuccessful on account of the proximity of the speaker and hearer, and from not having suitable terminations to the line of wire used.

Further experiments, however, showed that, when the ends of the wire were sufficiently far apart, and by using as terminals simple pasteboard disks, or boxes, no difficulty was experienced in transmitting vocal sounds.

Various experiments were afterward made from time to time. These experiments were repeated under various conditions as to distance, nature of wire used, and forms and quality of terminal mouth and ear pieces. To enumerate some of the more important experiments:

1st. About twenty yards of No. 40 copper wire were carried from house to outside, when speaking, singing, breathing, and musical sounds were easily transmitted.

This experiment was arranged in various ways. In the first trial the wire was kept free from touching any intermediate substance, and was kept in a moderate state of tension by the holders of the pasteboard disks at either end. Afterward it was found that, with suitable arrangements, the wire could be led from room to room, thus passing round corners, and that several persons could be in communication at the same time by simply joining on other terminals to the main wire.

2d. Several yards of No. 23 copper wire were carried from one room through an adjoining one and to a room beyond, the *wire rested on the carpet*, and was simply tightened a little at each end, and fastened to the floor with a carpet tack. Two attachments were then made of a similar-sized wire, and the doors leading to the rooms in connection were *closed above* the wire.

Conversation, musical, and other sounds were then readily transmitted.

In some, after experiments, No. 16 copper wire was found to give better results.

Another and somewhat similarly-arranged experiment was made, in which the wire was carried from one floor of house to another, and messages transmitted.

3d. Attachments were made to a line of telegraph wire and various forms of terminals tried, when it was found that musical and other sounds were readily transmitted. The attachments were made by No. 23 copper wire, and the experiments were tried at distances of seventy five and one hundred and fifty yards. It was found that there was no appreciable loss in the intensity of the sounds at the greater distance, although an intervening post had to be passed. Breathing, whistling, singing, and the sound of a small tuning fork were readily transmitted. Speaking was indistinct, although the word sounds were discernible.

The author believes that, under more favorable conditions, communications might be made in this manner through considerable distances.

4th. About fifty yards of No. 23 copper wire were laid out on grass and fastened up at ends to pins; attachments were then made and vocal and other sounds transmitted.

The terminals used were composed of various materials, and were of various forms—the best results were, however, got when the disk or vibrating parts were of pasteboard. If the disks were set in deep rims, clearness of speech was best got by speaking back a few inches from the mouthpiece. With shallow rims the sounds were sharper, but not of such volume.

The best results were got when the wire was attached to center of disk. Good results, however, were got, although the attachment was made in various ways.

The wires tried were of copper, steel, and iron; the copper wire, however, gave the most satisfactory results. In the case of the telegraph wire, which would be about one-eighth of an inch thick, and of iron, the volume of sound was considerable; and, indeed, the volume of sound seemed to be increased with heavy wires.

Some interesting results were got by using a common iron wire fence, and attaching terminals at various points apart in the wires of which it was composed. The fence was made up of six wires of three sixteenths of an inch and one-fourth of an inch diameter, and had iron supports at every six feet of its length.

It was found that speaking, singing, whistling, etc., could be transmitted through distances varying from twenty to sixty yards, and that the sound of the tuning fork passed through one hundred yards.

Attachments were made to ordinary bell wires, and speaking, singing, etc., could then be transmitted from one room to another.

In all cases the individual voice could be distinguished, and sounds not immediately addressed to the transmitting disk could be heard. Two persons singing together could be heard very beautifully.

The vibratory movements of the disks were insufficient to cause fine sand strewn upon them to move.

From his experiments the author believes that a large part of the vibratory movement must take place in the interior of the wire. This at least seems obvious in the case of the wire resting on the carpet, which showed an improvement in clearness of transmission, when kept still, by resting on the surfaces with which it was in contact.

From the fact that whisperings and breathings can be transmitted through considerable distances, it is evident that a very small part of the energy expended at the sending terminal can be lost by inducing permanent strain, or by heating the particles of the wire during the transit, and that, in consequence, with suitable arrangements, messages might be transmitted for considerable distances.—*Telegraphic Journal.*

[The author does not appear to be aware that telephone lines working without electricity have for several years been in common use in the United States. Hundreds of miles of such lines are in use. The lines rarely exceed one mile each in length.]

THE REESE FUSING DISK.

DAY by day additional evidence is supplied that we know next to nothing concerning molecular physics. At one time we are startled by Mr. Crookes' discoveries, and we hear of a fourth state of matter. Then the telephone, and afterward the microphone, taught us that much yet remained to be learned concerning the interaction of particles or molecules in apparently the most rigid substances. We venture to think that the action of the Reese fusing disk affords more matter for wonder than even the microphone itself. Indeed, were it not that we know from apparently trustworthy evidence that the disk is actually in use in several American ironworks and machine shops, that it is not a laboratory instrument, but a useful tool, we would be disposed at once to reject all the statements concerning it as totally untrustworthy and false.

Our engravings illustrate the machine as made in the United States. It is employed to cut bars of round steel. At the first glance it will be seen that it resembles a cold saw, but its action has nothing in common with that of the saw. It is well known that a disk of soft iron caused to revolve at a very high velocity will cut a hard piece of steel through, if the steel be brought in contact with the edge, but the Reese disk, it is said, *fuses a bar of steel across without touching the bar.*

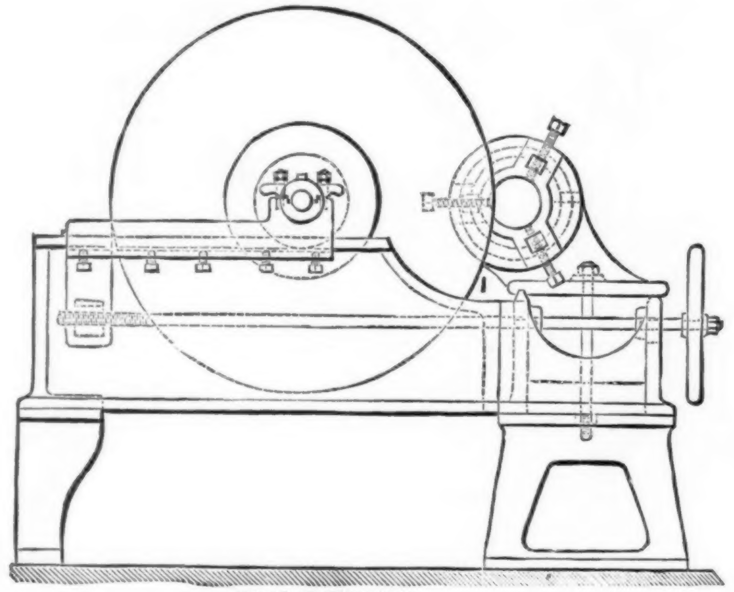
The machine consists, it will be seen, of a disk of soft steel, three sixteenths of an inch thick and 42 inches in diameter, and making about 230 revolutions per minute, which gives an angular velocity of 2,500 feet per minute. The bar to be cut must be round, and it is placed in the chuck in front of the disk, and caused to make about 200 revolutions per minute in the same direction as the disk; that is to say, the edge of the disk and the surface of the bar move in opposite directions. Thus adjusted, the disk not touching the bar, but close to it, a round bar of steel, 1⅝ inch diameter, can be fused in two to ten seconds, the appearance of the cut and the position of the disk with regard to it and the bar being shown in the diagram.

In bringing so extraordinary a statement before our readers, it is proper that we should supply them with the evidence on which the statement is based. We first learned from an American contemporary, the *American Manufacturer*, that the Reese fusing disk was being fitted up at certain establishments in Pittsburg, and it somewhat vaguely spoke of this disk as an apparatus for cutting cold steel by a current of air. We at once wrote to Mr. Reese, of Diamond street, Pittsburg, and we have received from him a letter which conveys the information we place before our readers.

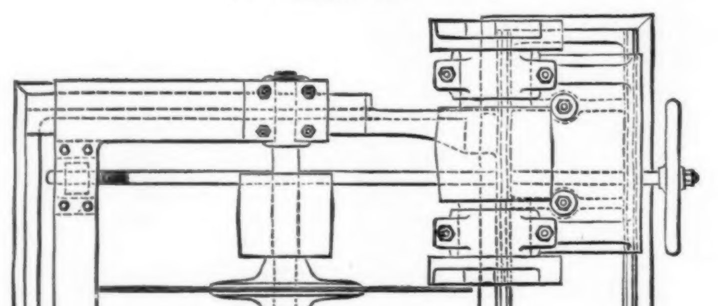
It will be observed that the disk is only three-sixteenths of an inch thick, while the groove fused in the bar is five-sixteenths of an inch wide, leaving one-sixteenth of an inch of play at each side and one-eighth of an inch clearance in front. "We have," writes Mr. Reese, "adjusted the disk mandrel on centers, and satisfied ourselves that no lateral motion took place, and yet the air space always existed. The ends cut show no sign of having been touched by the disk, the result of the fusion is metal, and the molten metal, while running down, may be handled by the naked hand without detecting but little temperature. The ends of the bar operated on become heated, the disk remains perfectly cool." It must be understood that the phenomena we have described *are only present when the bar to be cut is caused to revolve.* If the bar is not turned the disk cuts its way through it as a cold saw would, but the discharge from the cut is not metallic, but an oxide of iron. The use of the fusing disk is, therefore, confined to round steel bars of moderate diameter.

It is very difficult to explain the phenomena in question on any hypothesis consistent with our existing knowledge of molecular physics. That a bar of steel caused to revolve close to the edge of a disk running a very high velocity should be fused without contact taking place between the two is a wonderful fact, which may stimulate the energies of ingenious minds for a solution for some time to come. Mr. Reese's explanation is that the fusion is due to the transfer of the mechanical energy stored by the saw in the air flying from its rim into heat. The explanation is best given in his own words: "The disk is surrounded with an atmosphere of air at a pressure, say, 15 lb. to the square inch. This air, by virtue of the motion of the disk, is thrown outward in radial lines and is projected from the periphery. Temperature being the measure of molecular velocity, as weight is the measure of matter, it follows that the increased velocity acquired by the air in passing off the disk will indicate a large increase of caloric. A part of this is drawn from the disk, which is thus kept cool, the remainder is obtained from the atmosphere. The increase of heat is not sensible, as it is occluded—latent—by the distended condition of the molecules. When the air is thrown off of the periphery of the disk, it tends to follow—or a portion of it—the disk, as our atmosphere follows the earth, the bar of metal impeding the flow of the air around the disk, the impact condenses the air, retards its velocity, unlocks the occluded heat, and fusion takes place. At the instant fusion takes place the molecular velocity of the metal is so suddenly increased, and is so great, that it possesses no sensible caloric above the atmosphere, all the balance being occluded; and as no occluded caloric can be unlocked except by a reduction of the molecular velocity, the metal is, therefore, apparently cold, though in a molten state. The more experience I obtain the more strongly am I impressed that the imponderable physical agents are the prime factors of all the chemical and physical phenomena we observe, and that physics should be more earnestly studied."

Mr. Reese is a metallurgist of some standing, but it is not quite easy to follow him, or to extract his meaning from the passage which we have quoted; yet on examination it will, we think, become intelligible. If we conceive the disk to project a constant shower of particles of solid matter against a surface, it is clear that that surface would soon be raised in temperature, for the same reason that a wire becomes hot when hammered, and that the molecules of a gas are able to play this part is also known; but when we have got thus far, we are left face to face with an aspect of the problem which Mr. Reese has not attempted to solve. Why should it be essential that the bar to be cut should be round, and that it should revolve in the same direction as the disk? There appears to be no connection whatever between the revolution of the bar and its fusion. We shall for the present make no attempt to offer an explanation of the cause of the phenomena, because we are not as yet in possession of a sufficient number of facts. The explanation that at first

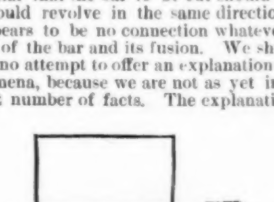


SIDE ELEVATION



PLAN.

THE REESE FUSING DISK.



presents itself is that fusion of a portion of the bar is set up at first by the disk coming in contact with it, and that the steel thus melted is burned by the air current, and that, in fact, the bar is *burned* through. It is well known that a small bar of rod iron, such as a nail rod, may, if heated to a bright red, be made white hot by blowing on it with a pair of smith's bellows. But if the bar were burned through, the discharge from the cut would be oxide of iron, whereas it is, according to Mr. Reese, metallic iron or steel. But

when the bar to be cut does not revolve, then the discharge is oxide of iron. For the moment we leave the subject in the hands of our readers, only adding that we have no reason to doubt the truth of Mr. Reese's statements.—*The Engineer.*

IMPROVED MICROSCOPE.

By PAUL WAECHTER, Berlin.

THIS new microscope, although it occupies only a small space, admits the placing of microscopical objects upon a glass plate, having an area of 50 q. cm. (7·44 sq. in.), and the examination of every part of them with the same exactitude. The object table consists of two circular glass plates, having a diameter of 8 cm. (3·12 in.) and a thickness of about 5 mm. (0·24 in.), which are screwed together at their center by a metal knob that serves at the same time to modify the pressure upon the microscopical objects lying between these

plates. One of the two plates—the object table proper—is divided into four equal parts, furnished with four plainly visible numbers, which prevent the experimenter from mistaking one microscopical preparation for the other. When the microscope is used the object table can be slowly turned around its axis by a slight pressure of one finger. The end of each quarter-rotation can be felt by the resistance offered by a little spring. The movement of the object table is regulated by a system of screws.

MODERN MICRO-PHOTOGRAPHY.

Two months ago we announced in these columns an important discovery made through the medium of photography. We showed how the micro-camera was able to see minutely where the eye was at fault, the discovery made by the sensitive film in this case being not simply a bare scientific fact, but a matter calculated to influence everyday life, and bearing vitally upon our knowledge of surgery and blood poisoning. We showed how a clever micro photographer, Dr Koch, had come to the aid of Professor Lister, of King's College, and adduced photographic proof of the wisdom of the medical treatment pursued by that eminent surgeon—treatment, we are glad to say, that has lessened the percentage of deaths among surgical patients in our hospitals in a wonderful manner.

Mr. Lister's theory, it will be remembered, is that pyæmia, blood-poisoning, and the other terrible diseases that so frequently supervene after a surgical operation, are due wholly and solely to bacteria, or tiny organisms that are for ever floating around us. These bacteria pervade the air we breathe and the dwellings in which we live, and are unceasingly seeking an opening to do mischief. An incision in the human body affords them a glorious opportunity; but Mr. Lister, by making abundant use of carbolic acid, which is lavishly applied to operating knife and bandages, manages now to keep them at bay. But the difficulty has been to bring the crime home to the bacteria. Under most circumstances there is little difficulty in detecting them with the microscope, but when they bury themselves in human tissue, all trace of them is lost to the eye, and indeed the doubts that were thrown by some upon Mr. Lister's theory were due in a great measure to the fact that the surgeon was unable to demonstrate the actual presence of bacteria in the tissue.

This we know Dr. Koch has now done. Tiny organisms, of the same color as the tissue itself, he has been able to discover and magnify some 700 times. He does it by staining the tissue violet first of all, and then making use of a very simple and efficient method of lighting his preparation. This method we now bring to the knowledge of our readers. Artificial illumination was not powerful enough, it seems, and direct sunlight gave images so hard that the detail of the delicate little organisms was destroyed. In the end, he found that by passing sunlight first through an ammoniacal solution of copper—a blue liquid, be it remembered—and still further diffusing light by ground glass, he was able to solve his difficult problem. In Dr. Koch's case, of course, the lighting was the main difficulty, and our readers will be glad indeed to read the doctor's own brief account of his *modus operandi*. He says:

"The micro-photographs that I forwarded to Professor Lister represent, for the most part, images magnified seven hundred times. I employed, for the purpose of securing them, an immersion lens by Siebert and Kraft, opticians of Wetzlar, and I may say that the instruments of these makers are particularly well adapted to micro-photographic work. Lens No. VII. was the instrument chosen by myself, and for my own part I prefer the system to that of Hartnaeker; I prefer it even to the oil immersion system of Zeiss, when the latter is not provided with a correction lens, or Woodward's so-called amplifier.

"The tube of the microscope—or, rather, the tube in connection with the microscope—was capable of drawing out to a length of two meters. The microscope and tube were horizontal, and, in place of the eye-piece, a small bellows camera was attached, care being taken, of course, to exclude light at the junction of tube and camera. I employed the wet collodion process, practicing it in the ordinary manner.

"I managed the lighting of the object to be photographed in the manner following. The object was a thin microscopic preparation, and so that sufficient illumination should be concentrated upon it, I employed sunlight, reflected by means of a heliostat. A wide angle condenser was, moreover, employed to concentrate this powerful light. At the same time, I did not use bare sunlight, which, as is well known, gives not only hard pictures, but pictures rendered defective by interference phenomena. I allowed the sunlight to pass through an ammoniacal solution of copper rendered as monochromatic as possible, and then diffused and softened it by allowing it to pass through ground glass. To this I attribute, in the main, the sharpness and purity of my pictures. Using diffused sunlight through ground glass in this way, I find that an exposure of about two minutes suffices in the case of an enlargement of seven hundred times.

"Of course, with gelatine, I shall be able to make shorter exposures, and I am just now engaged in making test experiments relating to its sensitiveness. I am also testing gelatino-bromide in respect to its sensitiveness in particular for violet and blue light, as also for green and yellow, my object being to see how far I can micro-photograph preparations stained blue; for in pathology and histology the microscopic preparations are, for the most part, of this tint. The question of color enters also largely into the matter when bacteria are to be reproduced; but I have little doubt that the gelatino-bromide process will lighten the labor of the micro-photographer very considerably."—*Photographic News.*

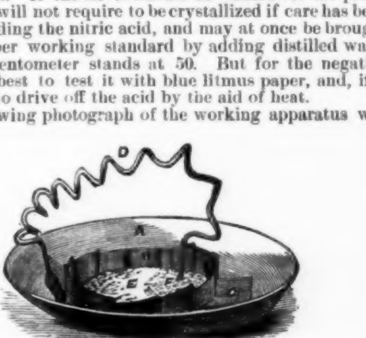
REDUCTION OF OLD SILVER BATHS BY ELECTRICITY.

By H. STONE.

FOR reducing old negatives and printing baths there is perhaps no process easier or better than that of precipitating the silver in the metallic form by means of the electric current, and as the method I am about to describe will require no more apparatus that are usually found in most photographic laboratories, it may be of some use to some of my fellow photographers.

Suppose you have got twenty ounces of old bath solution, pour it into a tall glass jar (a sweet-bottle will do very well, and may be purchased of any grocer for about two pence), and dilute it with an equal quantity of water; add hydrochloric acid till all the silver is thrown down in the form of chloride, which is to be collected by filtering it; the chloride being to a certain extent insoluble, and left on the filtering paper. You will now require a porous cell, made in the following manner: take a piece of white blotting-paper about eight inches in diameter, and place it on the top of a jar or any other cylindrical article about two inches less in diameter than the paper, and smooth it down as if you were going to make a cover; when you have got it to set properly, take it off, and your cell is finished. A piece of clean zinc plate seven inches long by four inches broad, with a copper wire soldered to one end, and a saucer, are now required. Place the zinc plate in the saucer, and on the plate put the paper cell. The silver chloride in the wet state must now be put in the paper cell, and the wire from the plate bent over the porous cell, and the end scraped clean and placed in the chloride. Pour diluted hydrochloric acid in the space between the saucer and paper cell; so as to half fill the saucer. It is then set aside for a few hours, when the chloride will be reduced to the metallic state in the form of a coarse gray powder, and must be washed to free it from hydrochloric acid and zinc chloride. Perhaps the best plan to wash small quantities is to place the precipitated silver in a tumbler and pour water over it, and after letting the silver settle, decanting the clear solution, repeating the operation two or three times. When it is washed enough, pour off as much of the water as possible, and add nitric acid, taking care to add only just enough to dissolve the precipitate, which it will easily do without the application of heat. If the silver nitrate be wanted for the printing bath it will not require to be crystallized if care has been taken in adding the nitric acid, and may at once be brought to the proper working standard by adding distilled water till the argentometer stands at 50. But for the negative bath, it is best to test it with blue litmus paper, and, if it reddens it, to drive off the acid by the aid of heat.

The following photograph of the working apparatus will



perhaps make the process clear. A is the saucer; B, paper cell; C, zinc plate with copper wire, D, attached; E, silver chloride, the dark portion marked F being the chloride reduced.—*Photographic News.*

SHOE HEELS OF COIR.

THE outside fiber of the cocoanut is now used in forming shoe heels. The product is said to be one of the best substitutes for leather thus far devised for the purpose. The disintegrated fiber is stamped into form under heavy pressure, apparently after mixing with some cementing liquid.

GLUCOSE.

(*Continued from Supplement, No. 259, p. 4127.*)

PROCESS OF MANUFACTURING GLUCOSE.

PATENTED BY JOHN F. WOLFF, CHICAGO, ILL., APRIL 13, 1880.

HITHERTO, says the patentee, in all processes for manufacturing glucose direct from the corn or other starch-containing substance there has always been great danger of coloring or burning the mass both in the operations of mashing and boiling with acid, as each operation required a long period of time. There has also been a tendency to decompose or sour during warm weather. It has also been impossible to secure a complete conversion.

The object of this invention is to obviate these defects, shortening the time of mashing and boiling, so as to lessen the danger of coloring or burning the material, overcoming the tendency to decompose or sour by a more perfect working of the material, and securing the conversion of a larger percentage of the material.

To accomplish this, the invention consists in introducing into one or more, or preferably all, the steps of mashing, boiling, and neutralizing, currents of oxygen, which at present can most readily and cheaply be done by forcing currents of air through the mass.

To enable others skilled in the art to use and practice my invention, I will now proceed to describe the manner of using it, taking as a basis the ordinary method of manufacturing glucose, but noting particularly the times and quantities best suited to my process.

The corn (or other starch-containing substance) having first been reduced by milling to the finest possible flour, is mashed by adding slowly to it three times its weight of water, which is thoroughly incorporated with it by stirring. The mixture is then heated slowly up to 60° Fahrenheit, at about which heat it is retained for from ten to twelve hours, the mass being all the time agitated by stirrers, and a current of air being constantly supplied to the center of the bottom of the mass by means of a rotary air pump or blower and a pipe leading therefrom to the center of the bottom of the vat or tank. By this operation all the starch-granules are opened and a fine mash is produced. This mashing process can be carried on in wooden vats of ordinary size and construction with steam heating coils, and the opening of the air pipe should be about an inch in diameter. The mass is skimmed, and is then ready to be boiled with the acid.

For every hundred pounds of mash I take two hundred pounds of water, and heat the water in a closed tank to 212° Fahrenheit, which tank is provided with a heating steam-coil and with an agitator, and is connected to the air pump or blower. To the water is then added the sulphuric acid, which, for the purpose of producing a sirup not intended to be crystallized, is in the proportion of one pound to every hundred pounds of mash. The sulphuric acid, diluted in four times its quantity of water, is added in a small stream to the hot water. A small but continuous current or stream of air is then turned on, the stirrers are started, and the mash is added in small quantities till the amount desired has thus been put into the tank.

With a tank of fifteen hundred gallons capacity, in which a thousand gallons of liquid can be worked, the mash should all be added within an hour and a half. While the mash is being added the liquid is kept constantly at the boiling point, and is continually agitated and supplied with air, the small quantities of mash put in each time permitting the temperature to be kept up which will produce the quickest conversion of the mash.

After the mash has been added the liquid is boiled for about three hours more, it being agitated all the time, and the stream of air being constantly introduced into the center of the mass at its bottom. When, by testing, it is ascertained that the starch has been converted into sugar, the heating-steam is shut off from the tank, but the agitation and supply of air are continued. The acid is then neutralized by adding to the liquid finely-powdered carbonized lime, using about one and one-fourth pound of lime to every pound of sulphuric acid in the liquid. The lime is added in small quantities (say a handful at a time), and the last two pounds of lime may be mixed with warm water and added to the liquid in a milky state, the agitation and air-supply being continued throughout this operation. The liquid is then tested for acid, and if none is found this step of the process is completed. The tank in which this operation is performed can be made of hard wood with a cover, and provided with an agitator and a copper steam-coil, in the usual manner. The tank can be connected with the air-pump or blower by a lead pipe having an opening one-half of an inch large. The boiling being completed, the contents of the tank are allowed to settle for twenty-four hours, when the liquor is drawn off through a woolen cloth. What sediment remains in the tank is washed thoroughly, and the sugar-holding water may be used when the next lot of mash is boiled with acid. The final settlings can be dried and used for food or fuel. The liquor first drawn off is then boiled in copper evaporators with large heating surfaces and connected with the air-pump or blower down to about 25° Baumé, a small current of air being admitted all the time. To the liquor is then added the usual quantity of bone-black, and it is then boiled down to about 30° Baume. After this the liquor is allowed to cool to about 145° Fahrenheit, which can be quickly accomplished by the continuous supply of air, and there is then added to it, for every one hundred gallons of liquid, two gallons of fresh blood diluted in two gallons of water. The liquor is then slowly heated up to the boiling point and retained at that temperature for about ten minutes. The air-current is then stopped and the black scum removed from the surface of the liquor, which is then drawn off into a tank for settlement, preferably through a woolen cloth. This settling-tank should be quite high and have several faucets, so that as the small bodies of lime sink slowly to the bottom the now perfectly white (water-white), clear, and transparent substance can be drawn off at intervals for the final boiling.

The final boiling of the mass down to the required consistency is done in the usual way, in a vacuum-pan, and the sirup is then passed over a cooler and conducted to the receiving tank, or is subjected to the well-known manipulations for making sugar.

To prepare a sirup especially for crystallizing into sugar I change the process slightly from that described. Four pounds of sulphuric acid (instead of one pound) are added for every hundred pounds of mash. After the mash is introduced into the boiling water and acid the whole mass is boiled for about five hours, instead of three hours, and the current of air is doubled during this boiling process. The liquor is then treated as before described until the final boiling, when the liquor should be

boiled down to 45° Baume. After being cooled the mass is agitated, and the result is a fine, white, and dry crystalline sugar.

The continuous air-current used by me hastens the mashing of the flour and makes the disintegration of the starch granules more complete and thorough. It quickens the conversion of the starch into sugar in the process of boiling, and assists the neutralization of the acid. It increases the facility with which the liquor can be cooled during the manipulations. It prevents through all the operations the coloring or burning of the liquor, and materially assists to make a purer and sweeter sirup, and one which can be crystallized into a dry sugar. If the mass is sufficiently light, the air-current alone will serve to agitate the same, and the stirrers can be dispensed with.

PROCESS OF MANUFACTURING GLUCOSE.

PATENTED BY CLINTON FURBISH, OF BROOKLYN, N. Y., APRIL 13, 1880.

THE object of the invention is to reduce the cost of manufacturing glucose or sweet liquor from corn, and to produce an article of superior quality, which, when made by the use of diastase, may be practically free from oily matters and from unconverted starchy matters; and it consists of a compound process, the first step of which consists of pearling the grain, or the reduction of the kernels by a dry clipping and cracking treatment, by which the hulls and heart of the kernels are separated from the hard starchy portions; and, second, the reduction of these starchy portions to a soft pulpy mass; and, third, the conversion of the starchy matters of this mass into glucose or sweet liquor; and in order that my invention may be fully understood I will proceed to describe the manner in which I have practiced it with success.

The Indian corn (shelled from the ear and winnowed) is subjected to the action of a cracking and hulling machine, such, for example, as is used in the manufacture of hominy. By the action of this machine the kernels of corn are hulled, clipped, and cracked, and the hulls and fine-clipped portions are separated from the harder portions of the grain. The hulls and fine clipped portions contain the bulk of the woody fiber and oily and albuminous matters of the corn, each of which may be separated, if desired, by a proper arrangement of bolts. The harder portions of the grain so obtained, containing the bulk of the starchy matters of the corn, are then placed in a close vessel or tank with water, and subjected to the effect of heat and pressure, by which means the mass is reduced to a pulpy state, and the starchy matters of the purified granular portions of the corn rendered peculiarly susceptible to the action of either diastase or acid for conversion into sweet liquor.

If acid is to be used, I prepare a suitable vessel or tank capable of holding the required pressure and provided with steam heating pipes. In this tank or vessel I place the diluted acid, and by connecting it with the first described tank am enabled by pressure to transfer the contents of the first to the second, and then by closing the second tank to proceed with the conversion by heat and pressure by the well-known and often described process.

If diastase is to be used, I discharge the pulpy mass from the vessel or tank into an open tank or vessel provided with a coil for heating and cooling and with a suitable stirrer or stirrers. By means of water running through the coil while stirring is continued I reduce the mass to a temperature of about 120° Fahrenheit, when I add a solution of barley-malt at a temperature of about 100° Fahrenheit, in the proportion of eight pounds of dry malt for every hundred pounds of dry corn treated as above described in the first step of my compound process; and I have found it best in practice to use in the vessel or tank in which the purified starchy portions of the corn are subjected to pressure about fifty gallons of soft water for every one hundred pounds of such dry starchy portions of the corn. After adding the solution of malt above described I gradually raise the temperature of the mass by passing steam through the coils, while stirring is continued until the mass attains a temperature of about 165° Fahrenheit, and I have obtained the best results by raising the temperature at the rate of 1° Fahrenheit per minute. When, by testing, either by iodine, alcohol, or by a saccharometer, I find the starchy matters of the corn thoroughly converted, I draw off the liquor, separating it from the solid residuum either by means of a filter-press, or by means of the action of a properly arranged centrifugal machine, or by any other suitable device. The liquor may then be filtered through bone filters and concentrated to the proper gravity required for sale, or it may be used unfiltered in the manufacture of malt liquors, alcohol, or vinegar, as may be desired. The sweet liquor so produced will be found practically free from starchy matters, and on this account peculiarly adapted for the manufacture of malt liquors.

The process as above described is not restricted to the use of a particular kind or exact quantity of malt, as rye-malt may be used for the purpose, and the quantity of malt may be varied as circumstances render expedient. Nor is the process restricted to the maintenance of the heat at the exact temperatures named, as these may be varied without materially changing the result.

IMPROVEMENT IN THE MANUFACTURE OF GLUCOSE.

PATENTED BY NARCISSE PIGEON, OF BROOKLYN, N. Y., MAY 21, 1878.

THE object of the process, taken as a whole, is to obtain the maximum quantity of grape-sugar and the minimum quantity of dextrine from a given quantity of corn or starch, and at the same time to obtain economically, in the process of manufacture, the largest possible amount of extract or saccharine matter.

The first step of the process is to add a certain quantity of diastase to the corn-mash, either previously to heating or before the temperature has reached 125° Fahrenheit, chiefly to prevent thickening of the mash by its chemical action on the starchy and gummy matter, thereby promoting subsequent exfoliation. In other words, the diastase keeps the mash as thin and liquid as possible, and in better condition for ultimate conversion into saccharine matter. After diastase has been added the mash is heated, by use of a water-bath, up to 185° Fahrenheit, at which temperature the vegetable albumen begins to coagulate. The mash is then allowed to cool to 152° Fahrenheit, when another quantity of diastase is added, for the purpose of effecting perfect conversion of the starchy matter.

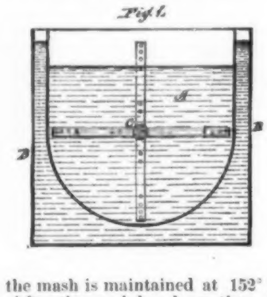
I show in accompanying drawings a vertical section, Fig. 1, and plan view, Fig. 2, of a water bath and mash agitator which I employ in carrying out my process.

The process itself is as follows. The quantity of Indian corn or maize to be treated is reduced to meal by the ordinary grinding operation. The inner chamber, A, of the water-bath, B, is then filled with the requisite quantity of water. After the water has been heated up to about 120° or 125° Fahrenheit, the requisite quantity of meal is introduced and mixed with it. I then immediately introduce a portion of the aggregate quantity of malt I employ in the process.

The proportions, by weight, of water, meal, and malt are as follows, to wit: Water, four hundred to eight hundred parts; meal, one hundred parts; malt, fifteen parts—that is to say, the quantity of water may be varied according to the desired sweetness or consistency of the sirup or wort to be produced; and in the first stage of the process above described, the proportion of malt used is five parts or pounds, the remaining ten parts being reserved for use in the second or last stage of the process, as hereinafter described.

At once the malt has been added to the mash, agitation of the latter is begun by means of the armed shaft, C, and it is also heated gradually up to about 185° Fahrenheit, not, however, by direct application of heat, but indirectly by raising the temperature of water-bath, A, to 195° Fahrenheit, beyond which degree it should never be carried. The mash is next cooled to 152° Fahrenheit, either naturally or by introduction of cold water into the water-bath, and continued agitation. I then add the residue of the malt, to wit, ten parts (or more), by weight, to one hundred parts of the meal, and keep up the agitation for one-half hour, the bath being at the same time kept covered. The mash is next allowed to stand one half hour, and again agitated a few minutes. It then stands another hour for the purpose of facilitating saccharization. During

Fig. 1.



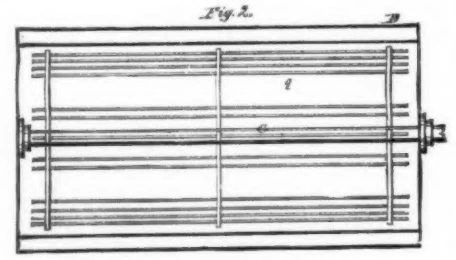
all this time the mash is maintained at 152° Fahrenheit, or thereabout. After the mash has been thus alternately agitated and allowed to stand quiescent, its temperature is raised to 172° or 175° Fahrenheit by raising the heat of the water in the jacket of the water-bath. After the degree of 172° or 175° Fahrenheit has been reached, steam is utilized for raising the temperature to 185° Fahrenheit, or even 190° Fahrenheit.

Throughout the process the temperature of the mash is never raised above 185° Fahrenheit, and hence the water in the jacket, B, is never raised above 195° Fahrenheit, or thereabout, this being the indispensable condition of the desired measure of success, since a degree of heat above 185° Fahrenheit will coagulate the vegetable albumen. It is equally indispensable that the mash shall not be subjected to steam heat or equivalent while its temperature is below 172° or 175° Fahrenheit; but when it has reached that point, it is then safe and practicable to employ steam-heat, which is, however, done only to save time, by quickly raising the mash to 185° Fahrenheit.

The steam-heat may be applied by means of a coil of steam-pipe in the chamber, A, of the water-bath, or directly to the water-bath, B.

By means of the water bath the heat is applied gently, and gradually increased to the required degree, so that the albumen of the grain particles is not coagulated, as it would be if a high heat were applied. Such coagulation will prevent rupture of the starch cells and the desired exfoliation, and, since exfoliation is the necessary precedent of sacchari-

Fig. 2.



zation, it results that when such coagulation takes place the ultimate effect will be the extraction of but a small per cent. of saccharine matter. The most important condition of success is, however, the fractioning of the malt—that is to say, its application in the first stage of the process, and also in the second or last stage. By adding the malt to the mash in small quantity at first and a larger quantity subsequently, it produces a widely different effect than when applied all at one time.

By my process it is practicable to obtain at least seventeen per cent. of dry extract or saccharine matter.

After the completion of the process as above described, I filter the liquor through a mash tun having a false bottom, arranged as charcoal filters are in sugar refineries, and spray the residuum with hot water for complete extraction. The sirup or sweet liquor thus obtained is then evaporated in vacuum pan to the desired consistency for use as wort. For table use, I concentrate the liquor in a vacuum pan to 20° to 30° Baume; then defecate with blood or other means; next filter through bag-filter and through bone-black, as practiced in sugar refineries. The sirup thus produced I concentrate to 40° or 42° Baume, and mix it with an equal quantity of cane-sugar sirup.

PHOSPHORESCENT LAMP FOR MINERS.

THE latest and not the least promising application of luminous paint is in the production of a safety lamp for coal miners. It is said to give light enough for practical use, and it is obvious that, in containing no fire, it is absolutely free from risk. By this invention, in connection with compressed-air blasting, fire and the attendant danger of exploding fire damp might be ruled out and the most dangerous mines made comparatively safe.

DETECTION OF THE COAL-TAR COLORS.

THE following paper was read by Mr. J. Spiller, F.C.S., before the Chemical Section of the British Association at the Swansea meeting, August, 1880.

"Dyers and others who are in the habit of using the coal-tar colors are familiar with a number of chemical reactions by which the members of the series may generally be classified and identified. Differences are remarked in their relative affinities for various sorts of fibers, some colors being taken up freely by silk, others fixing better upon wool, and some few, like saffranine, exhibiting a special affinity for cotton.

"Again, as with the yellow, great differences are observed when the operator proceeds to work with a free acid or a weak alkali in the dye bath, primrose (naphthaline yellow) requiring the former, but not so with phosphine (chrysaniline yellow), which requires a neutral, or even slightly alkaline bath.

"By the study of these conditions, aided by a few characteristic tests, it is often possible to identify coloring matters of unknown or doubtful origin, and it is with the view of extending the number of such readily available tests that I recommend a more frequent appeal to the color reactions with sulphuric acid.

"For this purpose but small quantities of material are required, a few grains serving to impart a distinct color to a comparatively large bulk of sulphuric acid, and the resulting indications are in many cases both specific and permanent.

"Oil of vitriol, which so readily destroys nearly all organic substances, does not carbonize any of the coal tar colors, or does so only under severe conditions, as at high degrees of heat. Even indigo and madder, though of true vegetable origin, are known to yield up their coloring matters to sulphuric acid, the old processes of dyeing depending upon this fact. In the manufacture of garancine from madder the woody fiber and organized tissues are destroyed by the action of sulphuric acid, while the alizarine glucoside survives, and with it Turkey-red goods may be dyed. Instances might be multiplied that coloring matters, both natural and artificial, resist the attack of oil of vitriol, and the large class of sulphonates (Nicholson blue, 'acid roseine,' etc.), may be cited as establishing the fact that coloring matters are not so destroyed, but form combinations with sulphuric acid.

"If, then, the body under examination be dissolved in strong oil of vitriol, a color test is at hand whereby useful inferences may be drawn as to the nature of the dye, and often its exact identity disclosed. A few direct confirmatory tests may then be applied. The most remarkable color reactions are the following:

Magdala (naphthaline pink)	Blue black.
Saffranine	Grass green, turning indigo blue if strongly heated.
Chrysoidine	Deep orange, turning almost scarlet on heating.
Alizarine	Ruby red or maroon.
Eosine	Golden yellow.
Primrose (naphthaline yellow)	Sparingly soluble, first yellow color discharged on heating.
Chrysaniline	Yellow or brown solution fluorescent.
Aurine	Yellowish brown; not fluorescent.
Atlas orange	Rose; turns scarlet on heating.
Atlas scarlet	Scarlet solution, permanent on heating.
Biebrich scarlet R	Blue black or deep purple.
Biebrich scarlet B	Bluish green.
Aniline scarlet	Golden yellow; permanent on heating.
Induline	Slate blue to indigo.
Rosaniline, regina, and all violets	Yellow or brownish yellow.
Phenyl and diphenylamine blues	Dark brown solutions.
Iodine green } Malachite green }	Bright yellow solutions, the former giving off iodine on heating.
Citronine	Pale cinnamon or neutral tint.

"After oil of vitriol the action of concentrated muriatic acid may next be tried, which distinguishes at once between saffranine and Biebrich scarlet, the former giving a violet solution and the latter being precipitated as a red flocculent powder.

"Proceeding in this way, and combining the observation with the dyer's usual tests, every one of the substances named can be readily identified, and much time saved in the examination of dyewares."

COLORS IN PATTERNS.

IN the colored branches of fancy cassimeres, the distribution or arrangement of colors in a pattern is of no less importance than the choice of weave to apply to it, and any person who has the least experience in the arrangement of colors in patterns will perceive that some colors will have more brilliancy and effect when placed together than when they are placed separate or beside some others.

This arises neither from taste nor imagination, but is founded in nature, and may be explained on the principles of optics, for it is well known that the seven prismatic colors have exactly the same relation to each other as the notes in an octave in music, and therefore the effect produced by artfully disposing of the kindred colors is no less pleasing to the eye than the concords of musical sounds are grateful to the ear.

Colors, therefore, with respect to the effect which they thus produce, may be arranged under two heads—namely, those which are contrasting, and those which are harmonizing. The contrasting colors are such as are most opposed to each other; the harmonizing colors are those intermediate tints which lie between the contrasting ones, and, as it were, blend them together.

The contrasting colors may be discovered by a very simple optical experiment. Place, for example, a red wafer on a sheet of white paper, and look on it steadily for some time until the eye becomes tired, and a ring of green will begin to appear round its edge; and even after the eye has been removed to another part of the paper, the green ring will

still be visible. Hence, green is said to be the contrasting color of red, and red, on the contrary, is the contrasting color of green.

In like manner it may be found that purple is the contrasting color of yellow, blue of orange, violet of a mixture of yellow and orange, and black of white.

The compounds of these colors will also have their contrasting and harmonizing ones. Thus, purple inclining to red, has for its contrasting color yellow inclining to green; purple inclining to blue has yellow inclining to orange; and so likewise with the other compounds. On the other hand, a harmonizing color will be the nearest tint to the original, but farthest, except the original, from the contrasting color.

Yellow is, therefore, the harmonizing color of white, orange of yellow, red of orange, violet of red, and blue of violet, etc.

Different shades of the same color, such as light and dark green, light and dark red, light and dark blue, etc., when they are distinct, form likewise very bold contrasts; but when the same color runs through a variety of shades, from a very dark to a very light tint, such tints approach to the nature of harmonizing colors.—*Baldwin's Treatise on Weaving.*

JUTE DYEING.

Red (11 lb.)

MORDANT hot for an hour with 8¾ oz. tannin; lift, wring, and enter in a beck of phosphine or aniline orange, and tap with a solution of saffranine at 113° Fahr.

Night Green (11 lb.)

Sumac at a boil with the clear decoction of 8¾ oz. sumac for three hours. Wring and enter in a beck of 1¾ oz. methyl green. If a yellower shade is wanted a little picric acid may be added.

Brown (11 lb.)

Boil 2 lb. 3 oz. cutch, and add to the clear decoction 3½ oz. bluestone. Enter at a boil and work for three hours. Lift, wring, and enter in a boiling water containing 8¾ oz. bichromate. Rinse and raise in a fresh water with 80 grains Bismarck brown, 5¼ oz. alum, and 17¼ oz. logwood.

Reddish Brown (11 lb.)

Mordant at a boil with 2 lb. 3 oz. sumac. After a few turns lift and add to the beck 1¾ oz. tin crystals. Give a few more turns, and make up a beck with 2 lb. 3 oz. logwood, 2¾ oz. magenta, 13¾ oz. alum. Work for an hour in this beck in the cold; lift and add to the same water 2¾ oz. chromate of potash; seven or eight turns, rinse and dry. —*Teinturier Pratique.*

A TRANSFORMATION OF WOOLEN FIBER.

ACCORDING to M. Heddebault, in the *Moniteur Industriel*, if goods containing a mixture of wool are exposed to a current of steam at a pressure of five atmospheres and a temperature of 300° F., the wool is modified to such an extent that it melts and collects in this state in the lower part of the vessel, while cotton, linen, and other vegetable fibers remain unchanged, and may be used in the paper manufacture, while the soluble body, named by the inventor azotine, is a valuable nitrogenous compound, and admits of various practical applications.

The *Chemical Review* says, "that as far back as January, 1858, we were informed that the firm of Hodgson & Simpson, soap and alkali manufacturers, of Wakefield, had come upon and were using a process substantially the same. They exposed mixed rags, etc., to the action of steam at the pressure of several atmospheres. The wool was rendered soluble, and was employed as a nitrogenous ingredient in chemical manures, while the cotton, etc., remained unaltered, and was sold to the dealers in cotton refuse. We are not aware whether the process is still in use anywhere in England."

NEW PROCESS FOR RENDERING NICKEL MALLEABLE.

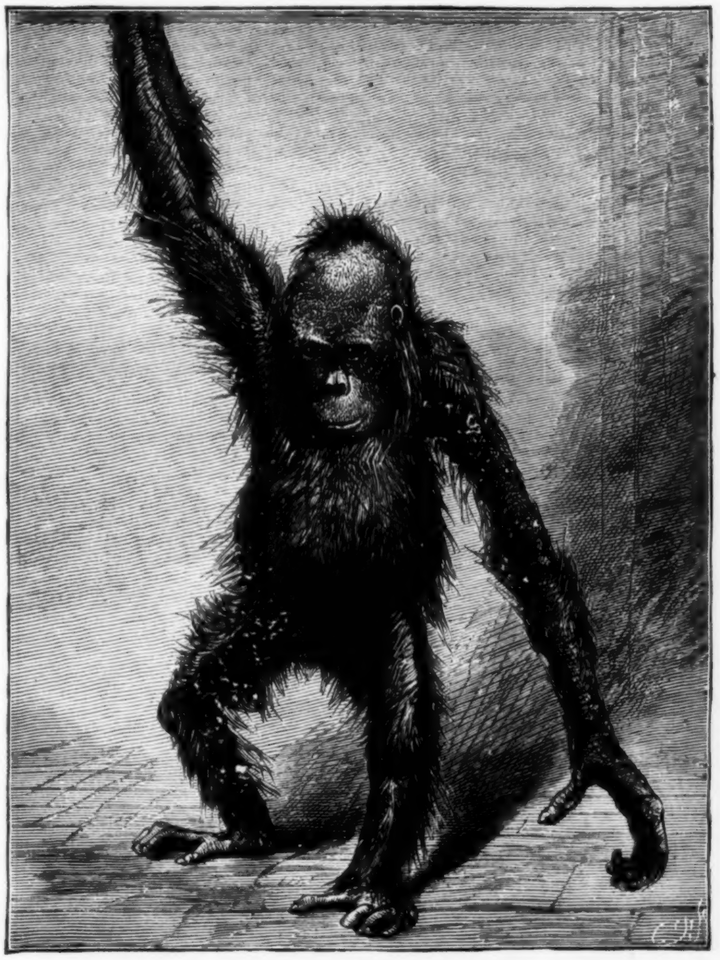
M. GARNIER, in a note presented to the French Academy (*Comptes Rendus*, p.331), proposes the addition of phosphorus to nickel to render the latter malleable. Besides the advantage it possesses in not disappearing (at least perceptibly) in recasting, and when it is present in the small proportion necessary, phosphorus removes a much greater quantity of oxygen than can any metal which is utilizable for the same purpose. Thus, while one unit of phosphorus removes 1.25 of oxygen in passing to the state of phosphoric acid, and 1·5 of oxygen in passing to the state of simple phosphate, one unit of manganese will remove only 0·3 of oxygen in passing to the state of protoxide of manganese, one unit of zinc will remove 0·25 of oxygen, and one unit of magnesium, 0·66. On another hand phosphorus acts on the metal in such a way as to give it all the characters needed in the arts, and its effect may be compared to that of charcoal upon iron. Thus, up to three thousandths of phosphorus, nickel is soft and very malleable, but above that proportion its hardness increases at the expense of malleability. One of the methods employed by M. Garnier to incorporate the phosphorus with nickel is to add to the nickel bath, in a suitable proportion, a phosphide of nickel containing about six per cent. of phosphorus. This he obtains by melting together a mixture of phosphate of lime, silica, carbon, and nickel. This rich phosphide is white, hard, and brittle. Nickel with the addition of 0·0025 of phosphorus can be rolled either hot or cold into sheets of extreme tenuity. It has been observed that on its first passage through the rollers the sheet shows all the defects that existed in the ingot, although these do not go on increasing during subsequent operations. This makes it important to obtain as sound an ingot as possible.

Phosphorated nickel alloyed with copper, zinc, or iron has given M. Garnier results much superior to those obtained with the same metal non phosphorated. The ingots were sounder, and this is explainable by the fact that the phosphorus in oxidizing in the mass of nickel does not give any gaseous products, but only solid ones. By means of phosphorus the author has been enabled to alloy nickel and iron in all proportions and to always obtain soft and malleable products.

WHEN potatoes are frozen the amount of sugar they contain is doubled, the starch undergoing a corresponding diminution, while part of the protein passes from the coagulable into the soluble form. During the process of rotting the potato loses half its nitrogenous constituents and the whole of the sugar.

THE ORANG-OUTANG.

IT is not given to many of us weaker mortals to take confinement and notoriety as calmly and philosophically as does the "Old Man of the Woods" (as he is somewhat irreverently called) at the Aquarium. There, sitting quietly on the floor, or hanging like some gigantic spider from the bar red roof of his cage, he regards his many visitors with a sad, half pitying, though somewhat sinister expression, and a sort of gloomy wistfulness in his dark eyes. He is about five feet high, and is covered with hair of a reddish color, excepting on his pate, which is benevolently bald. Under his red beard he has a peculiar pouch, the use of which is not yet clearly known, but is probably connected with his vocal organs. He is immensely powerful, his hands, with their small, tapering, but very strong fingers, being natural grapnels, by which, in his native woods of Malacca, he can swing himself from branch to branch and tree to tree, at a tremendous pace. As usual in the monkey tribes, his feet are more like hands, the great toe acting like a thumb. He cannot walk upright, and is obliged to use his long strong arms as a lame man uses crutches, and altogether his pedestrian efforts, if interesting, are not very edifying. His cry is peculiar and not easy to describe, but, when annoyed, there is no mistaking its significance. We believe this is the first adult orang yet seen in England; for though baby ones have been by no means uncommon, they have early fallen victims to our vindictive climate, and being naturally very delicate, are extremely difficult to rear. He is, therefore, regarded with great interest by naturalists, as well as by less scientific people, and it is hoped that "this beauty," as Mr. Frank Buckland enthusiastically designates him, will find a permanent home in London. The price asked for him is £150, and those very zealous gentlemen, the zoologists of Berlin, have already displayed considerable anxiety to obtain him. For our own part, we should like to see him returned to his native forests. The exhibition is depressing, and one cannot altogether escape a sense of wrong and inhumanity in seeing the poor animal caged up in so miserably confined a space. His every movement—every glance of his bright piercing eyes—is a silent reproach, and there is something absolutely touching in the grave, half weary pleasure which he takes in wrapping himself in his scarlet blanket.—*London Graphic.*



THE ORANG-OUTANG.

THE KALOULA.

THE order *Anoura* comprises tailless batrachians which are destitute of teeth. The common toad offers us a familiar example of such animals. While this reptile, however, has fingers and toes which are free and never dilated, there are certain other species in the order that have these members expanded into a disk, as may be seen, for example, in the common tree-toad. This same conformation is also seen in the *Dendrobates* of Chili, Brazil, and Cayenne; the *Brachymerus* of South Africa, and the *Kaloula* of India. The last named genus, *Kaloula*, comprises three species—the belted kaloula of India and Java, the painted kaloula of the Philippines, and the elegant kaloula of Siam, Sumatra, and the Philippines. The last mentioned species is now on exhibition at the Menagerie of Reptiles at the Paris Museum of Natural History, whither it was brought alive from North Sumatra by M. Brau, of Saint-Pol-Lias. The body of this animal is squat, short, and swollen, and its general aspect reminds one of the French frog *Pelobates fuscus*. The head is small and short, the ear is invisible, the tongue is broad, thick, nearly circular, and free only at its lateral edges; the eyes are large and salient, with a black pupil surrounded by a golden-yellow circle. There are a few warts on the back, and the skin is soft and unctuous to the touch. The posterior members are long, like those of frogs, and united at their base by a membrane, while the fore-fingers are expanded into a cushion-like disk. The animal is about three inches in length, but, including its hind legs, the total

THE KALOULA.

length is about six inches. The upper parts of the body are brownish, shaded with red and blackish, with a thin black line extending along the back. The eyes are connected by a brownish-green band which continues along the sides as far as the beginning of the posterior limbs. Another band of a grayish yellow extends from the angle of the mouth to the fore-leg. The throat is black, picked out with small white points, and the belly is rose color, marbled with brown. The fore-legs are brownish-green, branded irregularly with black.

The kaloula is a very timid reptile, and is able to hide itself quickly by digging into the earth with its fore-fingers and snout. It is rapid in its progress like the frog, and, when pressed by fear, makes a leap of about four inches. M. F. Bocourt, who has had an opportunity of observing the habits of the kaloula in its native country, states that the croaking of this toad, which occurs only during a night on which rain has fallen, may be well compared to the lowing of cattle. The animal utters very distinctly the two syllables, *ung-ang*, the first in quite a high, vibrating key, as if it issued from some metallic vessel, and the second in bass tone. These disagreeable and monotonous sounds are said to be very apt to put those who happen to be in the vicinity into a profound slumber.

THE FRIGATE MACKEREL, AUXIS ROCHEI, ON THE NEW ENGLAND COAST.

THE United States Fish Commission has obtained numerous specimens of a fish, before entirely unknown in the Western Atlantic. This is the frigate mackerel, *Auxis rochei*, twenty eight barrels of which were taken in a mackerel seine, ten miles east of Block Island, on the 3d of August, by the schooner American Eagle, Capt. Josiah Chase, of Provinceton, Mass.

The frigate mackerel resembles in some particulars the common mackerel, in others the bonito; the genus Auxis being intermediate in its character between the Scomber and the related genera Pelamys and Orcynus. It has the two dorsal fins remote from each other as in Scomber, and the general form of the body is slender, like that of the mackerel. The body is, however, somewhat stouter, and instead of being covered with small scales of uniform size, has a corselet of larger scales under and behind the pectoral fins. Instead of the two small keels upon each side of the tail which are so noticeable in the mackerel, it has the single more prominent keel of the bonito and the tunny. Its color is grayish-blue, something like that of the pollack, the belly being lighter than the back. Under the posterior part of the body, above the lateral line, are a few cloudings or maculations resembling those of the mackerel. The occurrence of a large school of this beautiful species in our waters is very noteworthy, for the fish now for the first time observed are very possibly the precursors of numerous schools yet to follow. It is not many years since the bonito became an inhabitant of our waters, and the distribution and habits of the frigate mackerel are supposed to be very similar to those of the bonito, *Sarda pelamys*, and the little tunny, *Orcynus alliteratus*, which also first came on the coast in 1871, and have since been found in considerable numbers.

The frigate mackerel has been observed in the West Indies and other parts of the tropical Atlantic as well as on the coast of Europe. In Great Britain it is called the "plain bonito." It is not unusual in the Bermudas, where it is called the "frigate mackerel," a name not inappropriate for adoption in this country, since its general appearance is more like that of the mackerel than the bonito, while in swiftness and strength it is more like the larger members of this family.

Since the first appearance of this fish many new observations of its abundance have been received. These fish seem to have come in immense schools into the waters between Montauk point and George's bank, and from Mr. Clark's statements it appears that they have been observed in small numbers by fishermen in previous years. Several vessels have come into Newport recently, reporting their presence in immense numbers in the vicinity of Block Island. It will interest the "Ichthyophagists' Club" to know that several persons in Newport have tested the fish, and pronounce it inferior to the bonito. Part of the flesh, that on the posterior part of the body, is white, but behind the gills it is black and rank, while the meat near the backbone is said to be of disagreeable, sour flavor.

It is hard to predict what its influence will be upon other fishes already occupying our waters. Its mouth is small and its teeth feeble, so that it is hardly likely to become a ravager like the bonito and the bluefish. There is little probability, on the other hand, that its advent will be of any special importance from an economical point of view, for its oil does not seem to be very abundant, and it would hardly pay at present to capture it solely for the purpose of using its flesh in the manufacture of fertilizers.

Mr. A. Howard Clark, in charge of the Fish Commission station at Gloucester, has communicated to Prof. Baird some interesting facts regarding its abundance. From these statements it would also appear that the species has been observed occasionally in past years. He writes under date of August 10: "I have received this morning from the schooner Fitz J. Babson, just arrived from Block Island, a fish answering to your description of the Auxis, having a corselet of scales around the pectoral fin as in the tunny. The captain of the vessel, Joshua Riggs, reports that about a week ago he had a hundred barrels in the seine at one time, and saw over twenty schools of them. He saw them as far east as Sow-and-Pig lightship. They are very easy to catch, flip like menhaden, do not rush, and are not frightened at the seine. They go in immense numbers, he thinks, as many as one thousand barrels to a school. The day after the appearance of these fish the mackerel disappeared, but he does not know whether the mackerel were driven away by them or not. They feed on mackerel food. Mr. Daniel Hiltz, of the same vessel, says that he caught one of just the same kind in February, 1879, on a haddock trawl on the eastern part of the Middle Bank in forty fathoms of water. He took it to Boston, where it was called a young bonito."

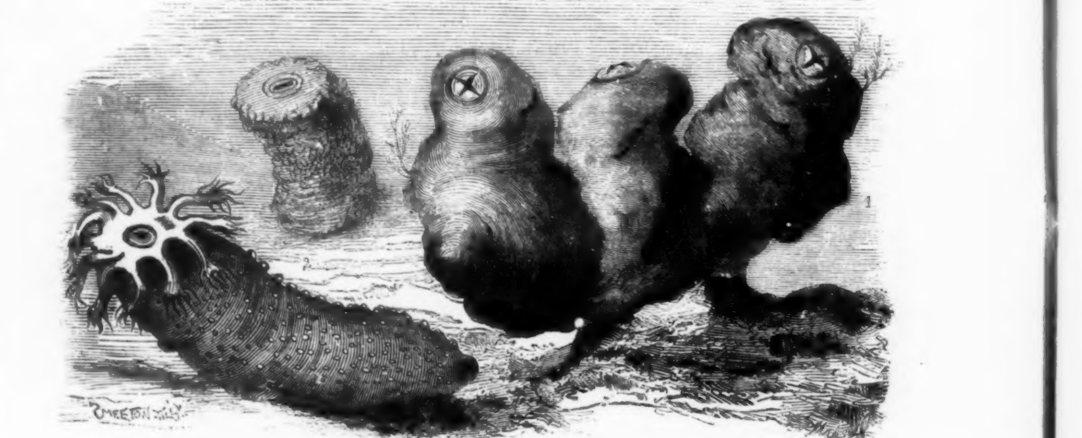
Mr. John Henderson, of the schooner Sarah C. Wharf, says that two vessels caught such fish recently, eastward of here; the schooner American Eagle, of Provincetown, took a number of barrels of them into Newport, and sold them for a dollar a barrel. Another Cape Cod vessel, he does not know her name took about fifty barrels of them and threw them away. All the mackerel seiners from Block Island report seeing quantities of this new fish within the past fortnight. The captain of the schooner Sarah C. Wharf, says he first saw them a fortnight ago some fifteen miles off Block Island. The captain and several of the crew of the Ella M. Johnson, of Newburyport, just arrived from Block Island, state they saw an abundance of the Auxis, but did not know what it was until reports came from you at Newport. They opened one and found in its stomach the ordinary red mackerel food. This crew differ with the crew of the schooner Fitz J. Babson with regard to the ease of capturing them—think them rather difficult to take; say they flip like porgies, and do not rush like mackerel; they saw ten large schools of them on Saturday last when some fifteen miles South of Block Island.

I hope that any reader of the *American Naturalist* who has seen this fish may mention it; some may, perhaps, have an opportunity of studying its habits. The length of those I have seen ranges from twelve to sixteen inches, and their weight from three-quarters of a pound to a pound and a half or more. Those sent to New York Market were part of the lot taken by the schooner American Eagle and brought into Newport, whence they were shipped by Mr. Thompson, a fish dealer of this place. It would require from eighty to one hundred of them to fill a barrel, so the estimate of Capt. Riggs that there are a thousand barrels in one of the schools, shows how exceedingly abundant they must be.

Capt. N. E. Atwood, of Provincetown, Mass., the veteran fisherman-ichthyologist, has examined the specimens, and is satisfied that they belong to the same species as fish which he found abundant in the Azores in 1840, when, led by the reports of Cape Cod whalers, he went to these islands in search of mackerel, the mackerel fishing being poor at home. No mackerel were found except the "frigate mackerel" referred to in this note.—*G. Brown Goode, Summer Station U. S. Fish Com., Newport, R. I.*,—*American Naturalist.*

SEA CUCUMBERS AND ASCIDIANS.

SEA CUCUMBER is one of the popular names of the *Holothuria*, which belong to the highest class of radiated animals. The name is derived from their generally elongated and more or less conical or warty form, some of the species resembling a prickly cucumber, except that the color is of a whitish brown. They are called "sea slugs," from their vermicular mode of creeping; and several of the East Indian species go by the name of "trepang" or "bêche-de-mer." The surface of their bodies is composed of a dense, tough, leathery skin, capable of being dilated or contracted, lengthened or shortened, at the will of the animal. No stony shell is deposited upon their bodies; yet this relationship to the urchins and star-fishes is manifestly shown by their apparatus of locomotive suckers, which are precisely of the same structure as those of the Echinus. As if, however, to manifest an affinity with the polyp forms, there still exists in the *Holothuria* a circle of branched tentacles, which surround the mouth. These are capable of being withdrawn into the body, but are commonly protruded in search of prey, which is seized and dragged to the mouth by these appendages.



SEA CUCUMBERS. ASCIDIAN.

There are very many species distributed throughout the seas of the world, but it is in the tropics that they most abound. On the New England Coast they are generally small, but in the Bay of Fundy and on the Banks of Newfoundland they attain a large size. On the mud flats of Florida they are sometimes seen more than a foot long and three or four inches in circumference. Several species of trepang are collected in the East Indies for food, the fishery for which, and their subsequent preparation for market, give employment to great numbers of Malays and Polynesians. The best are found on reefs of mixed coral and sand in the Fejee group, in one or two fathoms of water, and are obtained by diving. They meet with a ready sale at high prices in the Chinese markets. There are thirty-three different varieties enumerated by Chinese traders and others skilled in its classification. Fashion and custom have caused each variety to have a different market. While the gourmand of the south delights in juicy white and black kinds, the less cultivated taste of those of the north is satisfied with the red and more inferior varieties. It is minced down into a sort of thick soup by the Chinese, who are extremely fond of it—and, with some reason, as, when cooked by an expert, the trepang is a capital dish, and is rather a favorite with many of the Europeans at Manila. The trepang is also abundant on the coasts of Caledonia, and constitutes the most important branch of commerce. The preparation of the product for market is very simple. It is boiled in water for about twenty minutes, and then slit up from one end to the other and smoked and dried. A species found in the Bay of Fundy, and which attains a length of six to eight inches, is also said to be very palatable when boiled. Another curious sea food may be mentioned in this connection, although the animals affording it (*Ascidians*) belong to another division of the animal kingdom. Ascidians may be met with everywhere in abundance on the shores of the ocean, but very generally are passed unnoticed by the casual observer. They are molluscous animals incapable of locomotion, and deprived of any external organs of sense. Few animals seem more helpless and apathetic than these apparently shapeless beings. When we consider the immovable condition of an Ascidian, and its absolute want of any prehensile instruments with which to seize prey, it is by no means easy to conjecture how it is able to subsist; neither is the structure of the mouth itself, nor the strange position it occupies, at all calculated to explain this part of their economy. The internal surface of the bag is densely covered with cilia, which in the living animal are constantly in a state of rapid vibration, hurrying along whatever substances, alive or dead, may be brought into the body with the external element, and pouring them into the mouth, when they are immediately swallowed. Many forms of these tunicated mollusca are met with in the seas of tropical as well as temperate latitudes. It is only on the shores of the Mediterranean that they are gathered for food. One of the chief species used for this purpose is that represented in the engraving, the *Ascidia microcosmus*.

INCUBATOR EXPERIENCE.

As the year 1880 dawned upon "the greatest country upon earth" your correspondent made up his mind to get an incubator, and hatch out thousands of "broilers," for the hotels and restaurants of the surrounding cities in easy railroad distance. First comes the decision as to what one, of the many kinds, to buy. Circulars of all those advertised were procured. Each one, *of course*, was represented to be "better than the best"—thus adding to the confusion of views, and rendering the decision more difficult for a novice. Just here a lucky incident occurred. There was a grand poultry show to be held at which many machines were to compete for a handsome premium. Of course the assembled wisdom of the society and their poultry judges would help him in coming to a decision. All right! we will wait. "Patience is a great virtue," and you will perhaps decide whether the writer has any of that virtue, before the close of this article.

The show came off, and the successful machine was—well, let us call it "Smith & Jones'," for that will include a large family, and no one can say "It is I." *Of course* I procured the identical machine that won the premium. It "must be kept in a temperature not less than 60°." All right! I will put it in my office on the poultry farm, procure a large size Argand stove, lay in a store of coal, and defy Jack Frost. The deed was done—the incubator duly installed, rubbed down, warmed, batteries set in motion, hot water put in the boiler and evaporating pan, lamps trimmed and lit, and all in working order on the 14th of February.

Somehow the battery does not work right; well, we won't put any eggs in for a few days, but practice "running the machine," *to get the hang of it*, for a week. During this time, by devoting a good deal of time and ingenuity to the machine, we got it well in hand, and therefore decided to put the eggs in on the 21st. Auspicious incident—begin on the 21st, and it takes 21 days to hatch! So as not to run any chances, we placed a lounge in the office, and near the machine, to sleep on at night. One night a little puff! puff! awoke us, and we found one of the lamps flickering—some lamp black had fallen down the chimney and almost extinguished the light. After cleaning the lamp and refitting it, began investigating, and found that the smoke passed from the lamp up the tube to the bottom of the boiler, thence along the boiler to a tube leading to the "mother"—through a wide, shallow flue over the "mother"—to a big wooden smokestack. Having four elbows—most of which are inaccessible, the lampblack is liable to collect and in time choke up the machine.

Well, all things have an end, and this hatch of one dozen eggs (for experiment) had remained in the egg chamber 20 days. Of course due attention had been paid to keeping the heat at 103° to 104°, the eggs turned each day, and all duly taken out for airing, according to instructions, and on this 20th day, at noon, one chick hatched. There was a great rejoicing, to be sure. The machine *can* hatch chickens. During the night *four more* came forth from their fragile homes. . . . Alas! but five chickens hatched in all. They were left in the egg chamber several hours "to dry off," after which they were placed in the "mother." Meantime six dozen more eggs had been placed in the egg chamber.

After waiting more "developments" for two days, we broke the unhatched eggs of the first "sitting," and found they were in all stages of progress from the *almost hatched*, to the scarcely started stage. Mostly the latter. Of course *excuses* were now in order. Although we had paid an extra price to have the eggs carefully cared for as soon as laid, we concluded they must have got chilled before we received them. So in goes six dozen more, bought of a farmer near by, whose housekeeper is said to run as soon as she hears a hen cackle for fear the egg may meet with some accident. Now surely we will have success. This was March 13. March 18th, on waking up in the morning, went to call the half orphans to breakfast, and they did not respond. Come to find out, the heat of the lamp had loosened some more lampblack, causing the lamp to smoke. Now a very ingenious plan had been devised to cause a circulation of warm air in the "mother," by means of a tube leading from the vicinity of the lamp, past the boiler and into the center of the "mother." All the extra lamp smoke had followed this tube, and had smothered *all* the chicks. Being a son of

"poor but pious parents" we did not swear—but had a stress of thought.

Examined the eggs in the egg chamber and found but two infertile, so we kept up our courage, remembering "accidents will occur in the best of regulated, etc.," and on the 23d, when the next lot were due—failed to get one chick. Concluded they had been "deficient in fertility," knowing how some farmers keep too few cocks for their flocks, as we opened the whole six dozen without finding a half-built chicken.

March 26th, put in six dozen more eggs from our near-by farmer. Kept studying over the matter, and machine, for several days, and on April 5th, was tickled to find a lot of eggs pipped. We watched 20 chicks come out of their "arks," but two of them were too weak to last through the drying process. Meantime we had been to work under the advice of our inventor, and built an "orphans' home," of two stories, large enough to hold and care for 200 or more chicks. After a few days we put our 18 chicks in the "home," where they seemed to be real lively and grow and thrive spendidly.

April 15th. Another sitting began to hatch, and during this and the next two days 32 lively little chicks cheered us with their voices.

April 18th. Did not feel so cheered, for the oldest chicks began to act queerly. They laid around with their legs stretched out in very unseemly ways. In fact seemed to be all stiffened out. Thought perhaps they needed more warmth, and so placed them in warmer quarters, where they dropped off one, two, or three at a time. On the 12th we put in three dozen more eggs, and had kept the drawers full otherwise with fancy eggs. Once in a while a fancy egg would hatch, and the chick follow the process performed with the "hatchings."

May 3d. The three dozen lot of eggs were due, and *six* chickens hatched. Before they were a week old—two dropped off. Meantime it was getting to be a monotonous thing to have a chick getting a leg stiff and hobble around, and finally droop and die. To sum up the three months' effort—69 chickens hatched out of over 33 dozen eggs—and only 7 now living!

Possibly the writer did not care for them rightly after they were hatched, but he fed them the first two or three days on crushed cracker and yolk of egg, plenty of fresh water, milk, occasional green food and fresh meat chopped fine, and cracked corn, or scalded meal, or shipstuff, as they grew older. At first he thought perhaps he fed too much at a time, so he gave them less—only what they would clear off at a feeding, and fed them five times a day. But no use.

May 6th. A gentleman from Rochester, who was passing through the place, called to see the incubator. He said he had given some little attention to these matters, but asked no questions. Looked it all over "from truck to kelson." Then he turned to the writer and said:

"I don't believe you have had very good success."

"Well, no, not as good as I hoped."

"Of course not; don't you see that this horrible kerosene stench that the lamps give off permeates the air, and that evaporating pan is so placed that it keeps the air in the egg chamber filled with the poisonous odor? It will certainly destroy the vitality of the eggs, in general, and those that have enough vitality to hatch in spite of it, will almost certainly die soon after hatching."

"Well, you have quickly come to the decision I had arrived at after three months' faithful trial," said I.

These are *facts!* Until I had forced myself to come to the same conclusion as my visitor from Rochester had arrived at, I was fretting lest there were some stupid blunders on my own part. But he thus unwittingly confirmed me in my "views founded upon experience." If any one does not believe me, he can have a chance to prove the matter for himself, as I will sell him the machine.

I have procured everything I could learn of that related to the subject of incubators, and believe I can hatch eggs in a box with two pans, one to hold water and one to hold the eggs, with a lamp under the water pan. But I do not hanker after the job. With all my discouraging experience, I yet believe the hatching of eggs and rearing of chicks can be done successfully and on an extended scale. Who will tell us how—*from experience?—Penfield, in American Poultry Journal.*

THE MOVEMENT OF THE DIATOMEÆ.

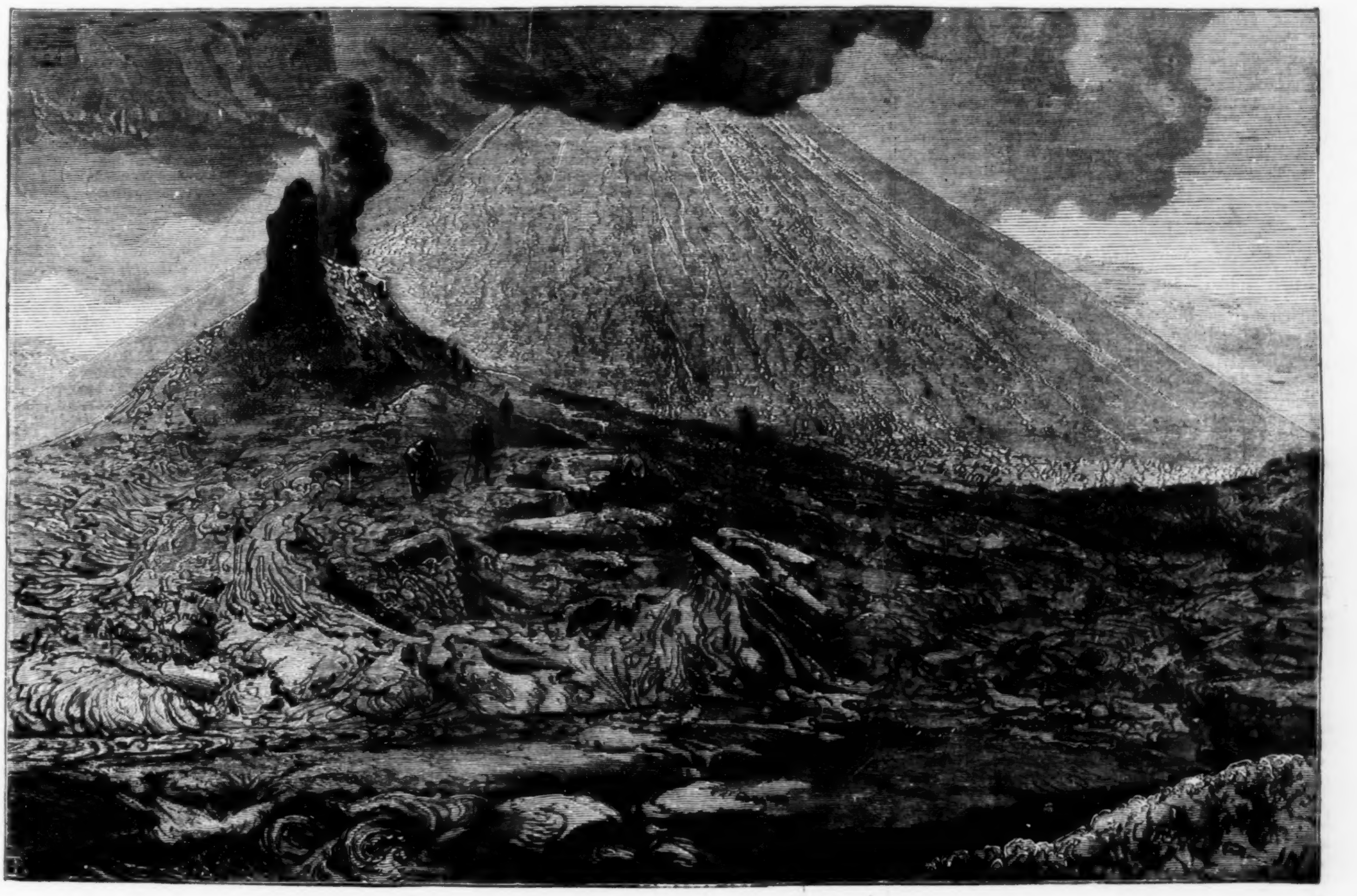
C. MERESCHKOWSKY, of St. Petersburg, has published in the "Botanische Zeitung" (1880, No. 21) "an article about the movement of the diatomeæ, a phenomenon well known to every microscopist, but the cause of which has remained hitherto unexplained. Mr. Mereschkowsky gives a description of this phenomenon as he observed it (at the Zoological Station of Napies), with three common species, viz., two *navicula* and one *stauridium*. These specimens showed a rectilinear progressing and retrogressing, the alga having not a horizontal, but an inclined position, and also a lateral rotation was observed, the upward turned end describing a circle, while the other end, sticking to the object carrying glass, formed the center of this circle. These organisms were surrounded by numerous infinitely small micrococci; those which were very near to the diatomeæ vibrated vividly, while those more distant were only moved by the surface-evaporation of the drop of water on the object glass. The whole phenomenon had the appearance of a current of water having entered behind the diatomeæ, which brought the small micrococci into a disorderly movement, and which was transmitted to a distance exceeding the length of the alga itself." The more or less distinct movement of the micrococci indicated that the maximum strength of the current was at the hind end of the diatomea, while at the front post a comparatively great stillness of the water prevailed.

Mr. Mereschkowsky gives also an explanation regarding the phenomenon. Since 1863 (Max Schultze) scientists have tried to find a solution for the movement of the diatomeæ, and two different hypotheses have been accepted, each of which excludes the other. The one assumes the existence of a protoplasma-layer at the inside of the shell of the diatomea, and maintains that this protoplasma-layer penetrates the pores of the shell inclosing outside the whole cell and producing the movement by contraction. Mr. Mereschkowsky says, correctly, that this hypothesis scarcely deserves any notice, because it is not justified by real observation, such a protoplasma-layer which would be able to produce the movement by contraction does not exist, as far as we know, and even if it would exist the movement which takes place by fits and starts could not be explained by it without erecting hypothesis upon hypothesis.

The other hypothesis is based upon the inner life of the diatomea, and maintains that the movement is caused by the energy of the diosmotic process. A living cell absorbs liquids continually, and a quantity equal to that which enters. By this process, movement must be produced, and this movement is said to be the reason of the current above described. Mr. Mereschkowsky defends the latter hypothesis, and sees in the phenomenon of movement nothing but the result of *osmosis*, a phenomenon, as it is well known, of great importance for the sugar manufactories.

VESUVIUS IN ERUPTION.

EARLY in the morning of Sunday, July 25, 1880, Naples was alarmed by a sharp shock of earthquake, which had been preceded by lighter shocks at regular intervals. The chief shock was undulatory from east to west, and was sufficiently strong to awaken all the inhabitants of Portici. The people were much alarmed. At the same time Vesuvius, annoyed possibly by the railway which has been laid upon his outer surface, began to growl and belch forth smoke, till at length in the evening several new fissures opened, sending forth streams of lava. It is worth noting that four days later a severe shock of earthquake was felt at Smyrna.—Our engraving is from a sketch by Signor Lazzaro, of Naples.—*London Graphic.*



THE ERUPTION OF VESUVIUS IN JULY, 1880.

THE TURQUOISE OF NEW MEXICO.

THE formation of the turquoise of New Mexico was explained as follows by Prof. Silliman in a paper before the National Academy of Sciences at its recent meeting. Prof. Silliman also exhibited a number of Pueblo-Indian relics recently found in excavations at Mt. Chalchuitl (Indian for Turquoise Mountain), in Los Cerillos, twenty-two miles southwest of Santa Fe. Among these were a large stone hammer of the hard hornblendic andesite, of which the mountains of the country are largely formed; a lamp, a pottery idol, such as are manufactured to this day; a spoon made of shell; a perfect specimen of a pottery dish, and some of the bones of the Pueblo or Indian miners, who were killed in 1680 by the fall of a large section of Mt. Chalchuitl, which had been undermined by them. These articles had been covered in the caverns for two hundred years when found. The rocks which form Mt. Chalchuitl are distinguished from those of the surrounding and associated ranges of the Cerillos by their white color and decomposed appearance, closely resembling tufa and kaolin, and giving evidence of an extensive and profound alteration, due, probably, to the escape through them, at this point, of heated vapor of water, and perhaps of other vapors or gases, by the action of which the original crystalline structure of the mass has been completely decomposed or metamorphosed, with the production of new chemical compounds. Among these the turquoise is the most conspicuous and important. In the seams and cavities of this yellow-white and kaolin-like tufaceous rock the turquoise is found in thin veinlets and little balls or concretions called "nuggets," covered on the exterior with a crust of the nearly white tufa, and showing on cross fracture the less valued varieties of the gem, more rarely offering fine sky-blue stones of higher value for ornamental purposes. It is easy to see these blue stains in every direction among these decomposed rocks, but the turquoise in masses of any commercial value is extremely rare, and many tons of the rock may be broken without finding a single stone which a jeweler or virtuoso would value as a gem.

That considerable quantities of the turquoise were obtained can hardly be questioned. The ancient Mexicans attached great value to this ornamental stone, as the Indians do to this day. The familiar tale of the gift of large and costly turquoise by Montezuma to Cortez for the Spanish crown, as narrated by Clavigero in his history of Mexico, shows the high value attached to this gem. It is not known that any other locality in America has furnished turquoise in any quantity. The origin of the turquoise of Los Cerillos, in view of late observations, is not doubtful. Chemically, it is a hydrous aluminum phosphate. Its blue color is due to a variable quantity of copper oxide derived from

associated rocks. The Cerillos turquoise contains 3·81 per cent. of this metal. Neglecting this constituent, the formula for turquoise requires: Phosphoric acid, 32·6; alumina, 47; water, 20·5. Total, 100·1. Evidently the decomposition of the feldspar of the trachyte has furnished the alumina, while the phosphate of lime, which the microscope detects in the thin sections of the Cerillos rocks, has furnished the phosphoric acid. A little copper is diffused as a constituent also of the veins of this region, and hence the color which the metal imparts. The inspection of thin sections of the turquoise by the microscope, with a high power, shows the seemingly homogeneous mass of this compact and non-crystalline mineral to consist of very minute scales, nearly colorless, and having an aggregate polarization, and showing a few particles of iron oxide. The rocks in which the turquoise occurs are seen by the aid of the microscope and polarized light in thin section to be plainly only the ruins, as it were, of crystalline trachytes, showing remnants of feldspar crystals, decomposed in part into a white kaolin-like substance, with mica, slag, and glassy grains, quartz with large fluidal inclosures, looking like a secondary product. There is a considerable diversity in their looks, but they may all be classed as trachyte tufas, and are doubtless merely the result of the crystalline rocks of the district along the line of volcanic fissures.

CLOUDS.

By PROF. S. A. MAXWELL, Morrison, Ill.

CLOUDS are masses of aqueous vapor condensed to such an extent by a diminution of temperature as to become visible. A given quantity of air will remain transparent so long as it is capable of absorbing watery vapor, and when it can absorb no more, it is said to be *saturated*. Even in this condition it is quite transparent; but if from any cause the temperature is lowered, a portion of the moisture is condensed, forming minute, though visible, vesicles of vapor, such as are seen floating in the air during a fog. These vesicles are hollow spherules sufficiently opaque to render the clouds which they form able to exclude the sun's rays either wholly or in part. The temperature of a saturated portion of air may be diminished in two ways—a cold current of air may enter it, or it may itself rise into a higher and colder stratum. The result of either of these conditions is usually the formation of clouds; and all or nearly all precipitation is due to the cooling of ascending currents at a vast height.

There are seven distinct varieties of clouds, arranged in two groups, known as primary and secondary. The primary group embraces the varieties called cumulus, stratus, cirrus, and nimbus; the secondary, the forms designated cirro-cumulus, cirro-stratus, and cumulo-stratus. This classification is quite faulty, as the words primary and secondary are not used in their true meaning. The word *primary* signifies pertaining to the first, hence *primary clouds* ought to mean the original or first forms of clouds—those forms which they assume at the beginning of their existence. Now, of the four varieties styled "*primary clouds*," but two, the stratus and the cumulus, can properly be called primary, as they only are original forms. A better classification is as follows:

CLOUDS.	I.	Primary or Original.	*a.* Stratus.
			b. Cumulus.
	II.	Secondary or Transformed.	*c.* Cumulo-stratus.
			d. Nimbus.
			e. Cirro stratus.
			f. Cirro-cumulus.
			g. Cirrus.

The processes of cloud formation and transformation are easily understood if we are sufficiently observing. The manner in which primary clouds originate has been briefly stated already, or rather that part of the subject relative to the formation of the cumuli—an interesting phenomenon which may be witnessed during the forenoon of almost any day in summer. The name, stratus, is applied to that form of cloud which often floats near the surface of the earth after a heavy rain-storm, also to those with which, in autumn and winter, the entire heavens are often obscured. A third though less common form of the stratus is sometimes seen during the evening of the cooler days of summer, and is caused by the settling of cumuli to lower strata of air. The lower portion of a cloud, when approaching the earth in this manner, is usually changed to invisible vapor, the air which it enters being warmer and consequently more capable of holding moisture. The rounded or conical form of the cumulus is by this means made to resemble the stratus, and after a short time, a perfect form of the latter will be produced by lateral expansion caused by gravity. This form of the stratus is short-lived, never being converted into any other kind of cloud—but is soon dissipated into invisible vapor. That form of the stratus which is often seen just after a heavy rain (particularly if the latter be followed by a strong east or south-east wind), is produced when the lower stratum of air is, in its parts nearest the earth's surface, too warm to be in a saturated condition, while at an elevation of a few hundred yards the temperature is so low as to cause the vapor to condense. When this phenomenon occurs there are usually two strata of clouds, one moving diametrically opposite or at right angles to the other. This form of the stratus is an original cloud, while that previously described is a modification of the cumulus. The direction taken by these clouds is one of the best of weather indicators. If, after a storm, they move *toward* the north-west, another storm is almost sure to follow. This circumstance generally indicates a large area of "low barometer," the center of which is still to the westward of the place of observation. If on the contrary, these stratus clouds move *from* the west or north-west, it indicates rising barometer, fair weather, and lowering of temperature. It takes comparatively little experience in weather observation for one to foretell the weather with tolerable accuracy whenever these clouds appear. The stratus is never transformed into the nimbus as some meteorologists have supposed. It is true that mist sometimes falls from these clouds, but even then there is so wide a difference between them and true rain-clouds—both in form and origin—that it appears unscientific to consider them rain-clouds. One reason why some have supposed that these forms yield rain or are transformed into rain-clouds, is doubtless due to the fact that the heavens being sometimes overspread with them, rain begins to fall and continues to do so for a considerable time and in large quantities. The truth is simply this: the stratus floats low and obscures the storm-cloud which is at a much greater altitude. The rain falls *through* the stratus, not *from* it—the rain-drops beginning their descent from points varying in elevation from two to ten times that of the base of the lower (stratus) cloud. This feature was particularly noticeable on the occasion of the great storm which passed over large portions of Iowa and Illinois on July 1st, 1878.

The stratus, more than any other form of cloud, has the power of absorbing light, or in other words it is a poor reflector. For this reason it always has a dark color, though its base is usually less dark than that of the cumulus. It is more uniform in color than the cumulus, while its edges are less sharply defined, both of which facts are due to the difference in their densities.

Let us now consider the cumulus. This is truly the cloud of day, its typical form never appearing in our latitude in the night, unless the weather is very warm for the season. The word *cumulus* signifies a *heap*, and is, therefore, definitive, giving a very good idea of the form of the cloud. These clouds are formed chiefly during the forenoon of warm days of spring and summer, by the condensation of the vapor contained in ascending currents of air. They attain their greatest height during the hottest portions of the day, at which time, according to Flammarion, they are 10,000 feet above the surface of the earth. In fair weather their thickness is rarely more than 2,000 feet, though no figures can be given as even approximately correct at *all* times; for latitude and temperature greatly modify both their dimensions and their altitude.

The cumulus, proper, is always an *original cloud*, by which is meant one formed directly from invisible vapor. Its base has a dark or black color, but the portions illuminated by the sun are of a beautiful white, sometimes changing to a yellowish or ruddy tint—to the former when there is much moisture in the intervening air, and to the latter when the air is filled with smoke or the so-called dry fog, characteristic of Indian summer. No cloud possesses more beauty than this—its clearly cut outlines and exquisite tints contrasting so admirably with the deep blue of the sky.

For this reason artists attempt its representation in their paintings, but commonly in a very imperfect manner, nature, in this instance, defying art with persistence and success.

The cumulus generally floats in the surface stratum of air. This can be verified by simple observation. The vane generally points *toward* the direction from which these clouds move. It is the cumulus which so often furnishes the temporary but refreshing shade to the weary out-door laborer, the severity of whose task is thereby greatly mitigated. It is the function of the cumuli to act as water carriers, and in this capacity is their chief merit found. Millions of tons of water are daily conveyed in this manner with the speed of an express train from one portion of the country to another. Sometimes this water falls as rain, and sometimes the clouds which it forms are dispersed and become again invisible vapor.

The two forms of clouds known as cumulo-stratus and nimbus, are but the cumuli in its more advanced stages of existence. When there is *low* barometer with high temperature, the cumuli, instead of dispersing, congregate in vast masses, sometimes disposed in ranges resembling mountains with domes and peaks rising grandly against the background of the sky. These clouds rise to an immense height, their summits frequently being 25,000 feet from the surface of the earth. Their bases vary in elevation from 3,000 to 5,000 feet, consequently, their vertical thickness is very great. The apex of a thunder-cloud in hot weather can be seen frequently on our western prairies, at a distance of two hundred miles. This fact can be proved almost any summer's day by means of the telegraph.

In treating of *causes* we necessarily touch upon their *effects*, hence in speaking of clouds we must speak also of the phenomenon of precipitation. Meteorologists hold different views concerning the direct causes which produce rain. Rozet and Kaemtz hold that it is due to the commingling of cirrus and cumulus clouds: the former being composed of frozen and the latter of vesicular vapor.

Now, I do not regard the cirrus as a *cause* of rain so much as an *effect*. The cirrus, if I may so term it, is the ashes of the storm cloud, being only an incidental product of the storm. If one of those scientists of Germany or France, who upholds the theory of Rozet, would spend one summer on our western prairies, he might see more than a dozen storms originate without a vestige of one of the cirri present in the visible heavens. It is a fact, however, that very soon after a cloud begins to yield rain, it assumes the so-called "carded appearance" on its almost vertical sides, and as the top becomes smooth a small horizontal fan of cirrus or cirro-stratus proceeds from near the summit, gradually expanding laterally and in front until it covers manyfold more territory than the true rain cloud from which it was developed. If our scientific friend should continue his observations of this shower, he might possibly have the privilege of witnessing how "storms die," for after the moisture of the cloud has mostly fallen as rain, he will notice the lower parts dwindling away, until by and by there will be no more "streaks of rain" under the cloud, and all semblance to the original cumulus or later nimbus will have disappeared—all that remains being a flat cloud, a true cirrus or cirro-stratus, which may dissolve in a short time and leave no trace of the storm or shower to which it once belonged. I have seen many instances of all these transformations, from cumulus to nimbus, from nimbus to cirro-stratus, from cirro-stratus to cirrus, and often the time required for these changes did not exceed an hour. It is much more common for the cirro-stratus to exist for several hours, then change to the cirrus, in which form it will float for days, moving in an easterly direction at an immense height. The little white films of cirri, which pass over us nearly every day, especially in hot, dry weather, are the ashes of storm-clouds whose force was spent on the peaks of the Rocky Mountains, or possibly on the briny waves of the distant Pacific.

The ascending currents which form the cumuli, and carry them to great heights, sometimes impart to them sufficient inertia to cause their entrance into currents of air having a temperature considerably below 32° Fah. When this takes place vesicles of vapor in the upper portions of the cloud become suddenly converted into buoyant frost-crystals, many of which speed away on the wings of the wind—the cold current moving much more rapidly than that containing the lower portions of the cloud. A large number of these frost crystals and spherules of ice descend into the lower and denser portions of the cloud, diminishing its temperature, thereby tending to produce precipitation; and no doubt in many instances rain does result from these conditions, though a far greater amount is caused by the cooling of ascending currents of humid air.

With regard to their *direction* of *motion*, clouds must, of course, take the direction of the current of air in which they float. In the different parts of the earth the direction of the prevailing wind varies. The direction of the cumulus and the stratus will usually be the same as the surface wind, while the direction taken by the other forms is more or less independent of it. Of these the cumulo-stratus and nimbus, being formed from the cumulus, usually (at least during the day-time) take the direction of the surface wind; but the cirro-stratus and cirrus almost invariably move in an easterly direction.

The cumulus, proper, as stated heretofore, is an original form of cloud, but there is occasionally a cloud which greatly resembles it, though it is a transformation. The cirro-stratus is a frozen cloud, but sometimes becomes reduced to vesicular vapor, and soon after it collects into little, rounded, fleecy masses called cirro-cumuli. When this process continues for a considerable time all the distinguishing characteristics of the cirro-stratus will become obliterated, and the cloud assumes the exact appearance of the cumulus. It never attains very great size, and owing to its immense height, appears almost motionless. It forms only in hot weather, and is quite often the harbinger of a storm.

The velocity with which clouds move depends mainly upon the velocity of the air-current in which they are suspended. The force of gravitation has a tendency to bring scattered clouds together, and when they have a common altitude, this is frequently the result. A large cloud obtains great additions to its volume in this manner—the small ones in its vicinity being gradually incorporated with it. I have observed this phenomenon more especially in the cumulus, and its derivative, the cumulo-stratus. It is obvious that this mutual attraction would in some cases accelerate and in others retard the motion of clouds; yet in no case would the effect be visibly perceptible. The velocity of clouds may often be very closely determined by noting the rate of speed with which their shadows move. The lower clouds which appear to move so very rapidly, frequently have a slower rate of speed than those apparently motionless ones far above them. This, of course, is due to the fact that the latter are from ten to twenty times more distant.

Though the clouds are classified and the different forms named, it is nevertheless true, that at certain seasons of the year, the typical forms are rarely seen in our latitude. It is a fact worth noticing that the rain storms of winter, in the northern parts of the United States are *not local showers*, but nearly all are great storms several hundred miles in extent, originating in a warmer latitude where the cumuli are the common day clouds in winter as in summer. The cumuli are germs of rain-clouds; hence, where the former do not exist, the latter will not originate.

It is not varying temperature alone that causes clouds to assume other than typical forms. As has been observed, there are frequent transformations, as the cumulus to the stratus, or the cirro-stratus to cirrus, therefore there is an infinite variety of transitional forms, which are classed among those with which they bear the closest resemblance.

The study of clouds is of much importance. If in this brief article enough has been said to stimulate some thoughtful mind to examine into it still further, and bring to light some more of the truths of science, the chief object of the writer will be accomplished.

To persons of æsthetic natures the study of the clouds is particularly delightful. Poets in all ages have adorned their verse with similes in which "the clouds" have constituted one element of the comparison. The same idea of cloud beauty has often been used by the orator on the rostrum, and the divine in the sacred desk, when they wished to adorn their speech with a jewel of metaphor.

A better knowledge of the science of meteorology is developing among the people of our country; and this is due in part to the efficient management of our Signal Service Bureau, and in part to the publication of numerous well written articles on the subject by observers in different sections of our country. It is to be regretted that so many statements (in reference to atmospheric phenomena), found in popular text books, should be so far from the truth as they are. That such errors should exist is to be expected, since daylight has but just dawned on the science of meteorology. But it is encouraging to know that the misty theories founded on ignorance and conjecture are rapidly giving place to those established by a careful study of the effects produced by the operation of natural laws.—*Kansas City Review.*

ON THE GREAT SOUTHERN COMET OF 1880.

THE elements of the great comets of 1843 and 1880 are so nearly identical as to render it almost certain either that the latter was a return of the former, or that the two are fragments of one original comet. On the former hypothesis the perihelion passage of 1843 was probably the first, as it is incredible that frequent returns of so brilliant an object should have escaped observation.

The identity of the comet of 1843 with that of 370 B.C., was suggested by Valz and is regarded by Cooper* as highly probable. The elements of this ancient comet (assigned by Pingré from the account given by Aristotle) seem not inconsistent with such a supposition. This comet is said to have separated into two parts. Granting the truth of this statement, may not the periods of the separate comets have differed to such an extent that the times of perihelion passage are now 37 years apart? Prof. Hubbard's elaborate discussion of the observations of the comet of 1843 gave a period of 530 years—liable, however, to considerable uncertainty. The interval between B.C. 370 and A.D. 1843 is 2,212 years. This is not a multiple of 530; but if we assume it equal to five periods of the comet we obtain for the interval between two consecutive perihelion passages 442 or 443 years. The last return previous to 1843 ought in this case to have occurred about 1401 or 1402. In November, 1399, a brilliant comet was seen, and in 1402 (only a year from the hypothetical epoch) two comets appeared, the first on February 8, the second in June, both of extraordinary splendor, and both visible in the day time.

The previous apparition, with the period assumed, was about 959. A comet was seen in that year from October 17 to November 1.

The year 519 was signalized by the appearance of a large comet. This was within two years of the date assigned by the hypothesis. For the return about A.D. 72 we have no recorded comet, or at least none whose path was nearly the same as that of 1843 I.

If the comets of 1843 and 1880 were both derived from that of 370 B.C., the mean period of Gould's comet has been 450 years, or between 7 and 8 years greater than that of the other fragment. The previous apparition would therefore have been due about 1430. Two comets are recorded in this, and one in the following year. A comet appeared also in the autumn of 981, very nearly at the epoch of the last preceding return. In 530 or 531 a large comet was visible in Europe, which Hind thinks was that of Halley. But "it

* Cooper's Cometic Orbits, p. 164.

is not impossible," Mr. Chambers remarks. "that there was a comet in each of the above years, a theory which might perhaps remove some of the discrepancies which exist on the assumption that there was but one." At the time for the apparition of 80 A.D. we have only the fact that in the year 79 "a comet was visible for a long time during the illness of Vespasian."

The perihelion distance of the comet of 370 B.C. was very small. Now it is sufficiently obvious, without any precise analysis, that in the case of a comet of small perihelion distance and considerable diameter, the mass, unless firmly held together by cohesive force, would be disrupted in perihelion by the difference between the sun's attraction on the central and the superficial parts. The fragments would thus be compelled to move in somewhat different orbits, like the meteoric streams of August and November. The disruption, therefore, of Aristotle's comet, as affirmed by the Greek historian, is not in itself an improbable occurrence. Besides the separation of Biela's comet, other instances of a similar nature might readily be specified.* In short, either of the hypotheses above suggested seems less improbable than that such a comet as 1843 I. or 1880 I. should have made frequent returns in modern times without being observed.

Should Gould's comet return about 1916 or 1917, we may conclude that it is identical with that of 1843; if not, the hypothesis of a common origin at a remote epoch may be regarded as probable.

DANIEL KIRKWOOD.

Bloomington, Indiana, U.S.A.,
Sept., 1880.

* See the author's "Comets and Meteors," Chap. VI.

CRUISING IN HIGH LATITUDES.

CAPTAIN C. L. HOOPER, of the United States Revenue steamer Corwin, has submitted to the Secretary of the Treasury a report of the cruise made by the Corwin in Behring Sea and the Arctic Ocean, in obedience to department orders of May 15 last. In it he says:

"On the 11th of September we saw the high hills of Wrangel Land, bearing W. ¼ E. (true). We ran in toward it until we came to the solid pack, the ice having the same general appearance as that we had previously encountered in the vicinity of Herald Island, except in being covered with newly-fallen snow and being consequently white. We judged the land to be about twenty-five miles away. The highest hills, which seemed to be more distant, were covered with snow; others were partly covered, and still lower ones were almost entirely bare. The sight of this land repaid us, to a certain extent, for our disappointment in not finding Herald Island clear of ice, as we hoped to do, in order that we might run lines of sounding and make a plan of the island.

"That part of Wrangel Land which we saw covered an arc of the horizon of about 50° from N. W. ¼ N. to W. ¼ S. (true), and was distant from twenty-five miles on the former bearing to thirty-five or forty miles on the latter. On the south were three mountains, probably 3,000 feet high, entirely covered with snow, the central one presenting a conical appearance, and the others showing rounded tops. To the northward of these mountains was a chain of rounded hills, those near the sea being lower and nearly free from snow, while the back hills, which probably reach an elevation of 2,000 feet, were quite white. To the north of the northern bearing given the land ends entirely or becomes very low. The atmosphere was very clear, and we could easily have seen any land above the horizon within a distance of sixty or seventy miles, but none could be seen from the masthead.

"I am of the opinion that Wrangel Land is a large island, possibly one of the chain that passes entirely through the polar regions to Greenland. That there is other land to the northward there can be no doubt. Captain Keenan, then commander of the bark James Allen, reports having seen land to the northward of Harrison's Bay, a few degrees east of Point Barrow. Large numbers of geese and other aquatic birds pass Point Barrow going north in the spring, and return in August and September with their young. As it is well known that these birds breed only on land, this fact alone must be regarded as proof positive of the existence of land in the north. Another reason for supposing that there is either a continent or a chain of islands passing through the polar regions is the fact that, notwithstanding the vast amount of heat diffused by the warm current passing through Behring Straits, the icy barrier is from 6½° to 8° further south on this side than on the Greenland side of the Arctic Ocean, where the temperature is much lower. As already stated, the nearest point of this land was fully twenty-five miles within the ice pack, and as the new ice had already begun to form, there appeared no possibility of reaching it. Even to remain in sight of it was to expose the vessel to great danger of becoming embayed in the ice, as the large quantity of drift ice which lay outside of us was likely to close in at any time and remain in the pack all winter. We, therefore, worked out into clear water and headed to the eastward."

THE FORMATION OF ICEBERGS.

AT the late meeting of the National Academy of Sciences, Lieutenant Schwatka read a paper on icebergs.

There were, he says, two theories as to the formation of icebergs, both of which had many admirers, and had been disputed with zeal and pertinacity. The first held that these crystalline mountains were of purely marine formation, while the second regarded them as glaciers, or fragments of glaciers, pushed into the sea by forces constantly operating in that direction. His observations had proved not only that both of these theories were correct in special instances, but that both agencies were sometimes combined in the production of the same mass. As a general rule, however, the former mode of formation prevailed in comparatively low latitudes, where the temperature was not only higher, but subject to a wider range of variation, while the latter was best observed nearer to the pole. Icebergs formed by dropping were usually smaller than those which rose from the sea—a statement which would be sufficiently verified in the course of his remarks, without going into evidences bearing upon the point in a special manner. By reference to diagrams prepared to illustrate the agencies at work in the formation of bergs, Lieut. Schwatka explained the protrusion seaward of fields of ice formed on shore, the excavation from beneath by the action of the waves operating at a temperature higher than that of the solid mass, and the ultimate fracture and plunge. The general ratio in gravity of ice to salt water for any given bulk being about as seven to eight the buoyant force of the water was, of course, to be expressed mathematically by one-eighth, and seven-eighths of an iceberg was usually immersed. This rule could not be applied without reservation, because a mass of ice generally contained other materials to a considerable percentage, but it would answer sufficiently well as a general statement to consider that seven parts of the mass were submerged, the remainder projecting above the surface; although it must not be concluded hastily that the submerged mass extended to a depth seven times the height of the apex. If the berg was tubular in shape, this was proximately true; if, on the other hand, it was pyramidal or conical—contours which were more common—then the mass submerged often did not extend to a depth greatly exceeding the apparent altitude of the apex. Sometimes, the water having eaten away the base, one of these tremendous masses performed a revolution on its horizontal axis, disturbing the surface for many square miles by the force of the concussion. There was no subject upon which observers differed more than upon the altitude of icebergs. Sir John Ross put the maximum at 50 feet, Perry at 258, Kane at 300, Hayes at 315, others at from 200 to 250 feet. The explanation of this discrepancy was to be sought in a fact familiar to Arctic travelers, namely, that the summit, except in extremely clear weather, was usually surrounded by a hazy mist, whose refractive phenomena deceived the eye as to the actual proportions of the solid mass inclosed.

From this general physical description of icebergs, Lieut. Schwatka proceeded to a discussion of their number as sometimes observed in a simple field of vision. Scoresby saw as many as five hundred at one time; at the mouth of Hudson's Strait, on Smith's Sound, in Baffin's Bay, and other bodies of water which were prolific nurseries of these ice-colossi, the number was often practically beyond the ability of the observer to register. The time of their breaking up was in July and August, and the phenomenon was a startling and magnificent one to persons unaccustomed to Arctic sights. An explosion like that of a magazine was followed by the sudden ascent of a cloud of vapor, whose prismatic reflection of the rays of the sun produced an effect as weird and brilliant as it was novel and beautiful. Some observers had described the form of the iceberg as abounding in fantastic shapes, simulating temples, mosques with lucid minarets, etc., while others spoke of their simplicity of outline as one of their striking features. In the far North, the point likely to strike an observer was the magnificent massiveness of their structure; but as they moved southward, the action of the more elevated temperature often worked them into the fantastic outlines described in poetic treatises, by wasting them away unevenly, and leaving the tall projections which were likened to spires. The explorer described a single iceberg formation observed by him during the expedition, which extended eleven miles along the adjacent shore. The mass was a gigantic ice-cliff 400 feet high and nearly perpendicular, and extended backward to a width of 1,600 feet. All the bergs originating in the valley of Spitzbergen were formed in this manner and cut off from the ice-fields behind them by the agencies he had previously described. In Nova Zembla, on the other hand, they resembled broken masses of ice, and were of smaller dimensions. The actual fall of an iceberg into the sea had only once been witnessed, so far as he had read the literature of the subject, and this consisted of the fracture of a stupendous ice-cliff with a terrific report. The fragment disengaged was a quarter of a mile in circuit, and was calculated to weight 421,660 tons.

THE ASCENT OF CHIMBORAZO.

The *Panama Star and Herald* of the 12th Oct. publishes the subjoined translation of a declaration made by one of two Ecuadorians who accompanied Mr. Whymper on his second trip up the mountain, which (says that journal), in addition to the word of an English gentleman and the evidence of his companions, ought to be satisfactory to all doubters. The declaration, which was written in French, is interesting as containing a simple and easy account of a difficult journey, as well as substantiating the verity of the first ascent: "I, Javier Campaña, of Quito, hereby declare that upon July 3, 1880, I accompanied Mr. Whymper to the very highest point of the summit of Chimborazo. We were also accompanied by Jean-Antoine Carrel and by Louis Carrel (Mr. Whymper's two Italian mountaineers, and by David Beltram, of Machachi. Mr. Whymper placed his tent on July 2, 1880, on the northwest side of Chimborazo, at a height, so he tells me, of about 16,000 feet, and he provided for the use of myself and of David the things which were necessary for an ascent—namely, good strong boots with large nails, warm gloves, spectacles to protect the eyes against the glare of the snow, and ice axes to help us along. We started from the tent at 5:15 on the morning of July 3, 1880, and at once commenced to ascend toward the summit. The way at first was over loose stones, but after we had ascended for about 1,000 feet we came to snow, and the remainder of the ascent was entirely over snow, with the exception of one or two little places, where rocks came through the snow. We stopped to eat on one of these little patches of rock at 8:35 A.M., and after Mr. Whymper had examined his mercurial barometer he encouraged us to proceed by telling us that we had already got more than half way up from the tent. From this place we saw the sea. We went on again at 9:05 A.M., and found the snow get steeper and steeper. We were all tied together with good strong rope in case any one should slip, and except for this and for things with which I had been provided we would not have been able to get along at all. Sometimes it was very cold and there was much wind, but when we were in the sun it was very hot. Whether in the sun or in the shade the snow was very soft, and we sank in deeply, often up to the knees. This was very fatiguing, and it was owing to this that we took so much longer time in ascending the upper than the lower part of the mountain. To break the ascent we zigzagged about, and at one time came round to the side fronting Guaranda, and then came back to above the place where the tent was pitched. At last we got on to the top and could see the two summits. The snow was very soft indeed here, and we went along very slowly, and had often to stop to get breath. The higher of the two summits was on our left hand—that is, upon the north side of the mountain—and we went to it, without going upon the lower one. As we approached the very highest point we saw that there was something strange upon it, and when we got up we found the pole of the flag which Mr. Whymper had put up on January 4, 1880. It stood up about 1½ varas above the snow, and very little of the flag remained, as it had been torn to pieces by the wind. I took a small piece of the flag to show to my friends below, and was filled with joy at being the first Ecuadorian to reach the summit of the great Chimborazo. We arrived at the very highest point of the summit at 1:20 P.M., and about the same time ashes from Cotopaxi began to fall. They filled our eyes, noses, mouths, and ears, and made the snow quite black. Mr. Whymper, however, prepared his instruments, and was at work during the whole time we were on the summit. He did not once sit down from the time we left the tent in the morning until the time that we returned to it in the evening. He took the height of the mountain with his barometers, and told us that the observations that he now made agreed very well with those which he made upon the first ascent of Chimborazo, on January 4, 1880. At 2.30 P.M. we left the summit and came down as fast as we could, only stopping a little from time to time to allow Mr. Whymper to collect rocks at various places. We arrived again at the tent at 5.10 P.M., and found it covered with the ashes from Cotopaxi, which were still falling, and filled the whole valley with a thick cloud. On the 4th of July we continued the tour of the mountain, and arrived at night close to Tortorillas; and on the 6th we returned to Riobamba, having had a most successful journey, without accidents of any sort whatever, not only having made the tour and the second ascent of Chimborazo, but having also made *en route*, on the 29th of June, the first ascent of Carihuairazo. FRANCISCO J CAMPAÑA. —Guayaquil, July 19, 1880.—Declared and subscribed at Guayaquil, this 20th day of July, 1880, before me, GEORGE CHAMBERS, Her Britannic Majesty's Consul, Guayaquil."

AN AMERICAN HERCULANEUM AND POMPEII.

AMERICA, as well as Italy, has its Herculaneum and Pompeii, if we may believe the reports of Messrs. Patterson and Mackley, two gentlemen engaged in mining in New Mexico, who have just arrived at St. Louis with remarkable specimens and more remarkable statements. Some stupendous ruins have been discovered at Abo City, in the Manzana or Apple Mountains, in Valencia county, about twenty miles west of the Rio Grande River, and nearly the same distance from the Atchison, Topeka and Santa Fe Railroad. The district was once very populous, but has now no inhabitants. We learn from a long report in the *Republican* that there is evidence of vast volcanic eruptions in the vicinity, which overwhelmed large cities and buried them and their inhabitants in hot ashes. There are lava beds fifty miles in extent, and at one time the crater of one of the mountains must have been sixty miles long and from fifteen to twenty miles across. The remains of a temple, with walls sixty feet high and ten feet thick, and covering an acre of ground, were found. The timber, which is pinon wood, was as sound as when first cut.

There is on one side of the piece of timber some rude figures, one of the All-Seeing Eye, representing probably the sun. Other figures are deeply indented in the wood, as if made by anything but a sharp-edged tool. Mr. Patterson says that he found stone hammers, but nothing in the shape of the sharp-edged or steel tools. There are small furrows seen in the wood, as if plowed out with a stone gouge. The building evidently belonged to a style of architecture anterior to the adobe and dried brick period. Mr. Patterson inclines to the opinion that the locality was the site of one of the seven cities mentioned by the Spanish chroniclers, the author of which traversed the country after the conquest of Mexico, among which were the cities of Camelone, Grand Cavra, Santa Cruz, Puerto de Abo, the Abo, and the old Pecos, and another situated a few miles west of Abo, in the lava beds.

Another specimen is a human skull, evidently that of a young female, as shown by the teeth, which was exhumed about half a mile from the church. Skulls are quite plentiful among the old ruins in the vicinity. About five miles from the Abo springs they have discovered some ancient silver diggings.

The smelters were built of adobe or sun-dried bricks, and were elevated some twenty or thirty feet above the surface of the ground. In digging down they found the remains of charcoal, which was used for fuel by the old smelters. There were also seen the remains of an aqueduct, in which water was conveyed from a spring, three-fourths of a mile distant, to a dam which diverted the water into the smelting works. About five acres was found covered with slag, which Mr. Patterson has taken up for a mill site. From the old furnaces a trail was found, after considerable exploration, leading directly from the smelting works to the mine in the mountains, which here rise in peaks to a height of ten thousand feet. The ancient trail pursues a zigzag course, having a length of some five miles, while, in an air line, the distance is not much exceeding one mile. Everything was transported in those old mining days on men's shoulders to and from the mountains. There are now trees of the "pinon" growing on the trail larger than a man's body, showing the antiquity of the path. Mr. Patterson said he was two weeks in discovering the mines after finding the smelting works.

The mine from which the silver was taken was concealed by fallen timber, some of which had taken root. It took nearly a fortnight to cart it away. It was found to be seventy feet deep, with several horizontal shafts. A lot of pottery was also discovered, and also a rich turquoise mine, which bore evidence of former working. The pottery consists of drinking vessels used by these old inhabitants of the country. The vessels are of various designs, representing several species of birds and antelope. Some of the specimens are striped and spotted with a black coloring. An old miner named Baxter found, in digging down a chamber about ten feet square, having on one side a fireplace, across which hung a crane having a clay hook, and at the end of the hook was a bone. On the opposite side of the fireplace was found the skeleton of a man in a sitting posture, who was evidently watching the bone roasting for his meal, when he and his habitation were overwhelmed in ruin by a sudden discharge of lava from the mountain.

MANURE CELLARS AND SHEDS.

MANURE being indispensable for the farm, its production and good management, when made, are very important. It cannot be so well kept in any other way as in cellars or covered yards. A cellar is the more convenient of the two, because much handling of the manure is saved. Much prejudice has been caused against manure cellars by the costly failures which have been made by those who have spent money for show rather than for use, and who have been badly advised by persons that have taken advantage of their willingness to spend money for pretentious and showy buildings. There are cellars which have cost thousands of dollars, that are walled with cut stone, and floored with flags or cobble stones bedded in cement. Some of these cellars have been arranged with a view to make them tributary to irrigation by liquid manure, a process which, as yet, our methods of agriculture are not prepared for.

There is no need to blame the cellar itself for these fail-

ures, for it may be built cheaply and made very useful for the saving and preparation of manure. The wall and the excavation alone are needed, and every barn should stand upon some kind of a wall for a foundation. If built upon a hillside, the excavation should not cost much, and in fact may be made to pay its cost by the improvement of the ground below it, as the earth removed may be used to grade up around the building, and a level yard may be made where formerly an inconvenient slope existed. The cost of the walls will be a very small sum as compared with the advantages gained. I would choose a manure cellar for its own special purpose alone, and not for a shelter for swine or for any other contingent uses, and would guarantee that it would pay a handsome interest on its cost. It need have no cemented floor, or be made a receptacle for the mass of liquid slush, for the liquids which naturally escape from the stables can be easily absorbed by the solid contents; neither need it be made offensive to sight or smell.

To keep the manure in a neat and inodorous condition is easy enough. The floor should be made slightly hollow and need not be cemented. The soil itself, although it be sandy or gravelly, will soon be able to retain even the liquid part of the contents, and if a few loads of absorbent material are spread when the cellar is emptied no loss will occur. If swamp muck, or leaves, can be procured, a foot or two in depth of these will be sufficient to retain the liquid, and if not, a few loads of earth may be spread, and when taken out will make excellent fine top dressing—a load of which will go a long way. All disagreeable odor may be prevented by sprinkling the stable floors daily with plaster, or even scattering a quantity over the manure below. The gutters in the stable should be provided with two or three tight trap-doors, through which the manure and litter may be drawn with a broad hoe or a dung hook. Grated floors in the stable are rarely to be recommended for common use. Manure should consist in large part of litter of some kind, by which it is made looser and easier to spread; its more open texture, too, assists the decomposition, and with litter grated floors are useless. Their purpose is solely to pass the unmixed droppings through into the cellar, where these accumulate in the shape of soft slush, difficult to handle or use in any way. With sufficient litter the heaps of manure which fall from the trap-doors may be spread and mixed with still more materials for composting, at intervals of a few days. The fact is, if a cellar is made and kept for the single purpose of saving manure, it will be found convenient and useful; but if it is made to serve other purposes as well, it will be apt to fail in all.

It is a question if covered yards can be made to pay their cost as yet. They are doubtless very convenient, and where cattle are kept in yards a considerable portion of the time they may be found desirable; but for mere protection for manure they will be found too costly, and at the present time the existing arrangements of yards and buildings would seldom admit of their use. In some cases where there is not a sufficient water supply, and yards are to be newly arranged, sheds may be profitably used under which to store manure. A number of cattle sheds forming a hollow square may open into a central yard, over the middle of which an open shed may be built. The roof of this and the other sheds would gather a large quantity of water. Every square foot of area covered would supply 26 gallons yearly, with a fall of 42 inches. With an area of 10 by 10 feet for each cow, a supply of 7 gallons a day would be provided from this source alone, which is entirely adequate if green food is used a portion of the season. The manure from the cattle sheds would be wheeled out to the covered portion of the yard, where it would be trodden by the cattle, and worked up into excellent condition. The cost of such arrangement is very reasonable. A sufficiently good shed for cattle may be put up at a cost of about $15 per head, and a covered yard would cost about 2½ cents a square foot. This is estimated for serviceable sheds; if ornamental work or paint is required, these would add to the cost mentioned. It sometimes happens that the more costly the buildings, the more labor is involved in the use of them, and the so-called modern improvements may not be always economical, while the cheaper kinds of buildings may turn out to be the more serviceable.—*Country Gentleman.*

A WONDERFUL JERSEY COW.

THE season's test of the remarkable butter cow Eurotas, No. 2454, which has been in progress for nearly a year at the farm of her owner, Mr. A. B. Darling, near Ramsay, N. J., terminated with her milk of October 15, at which time she became practically dry, and on November 4 she dropped a calf. It has been foreseen for some time by fanciers of the Jersey and of butter stock in general that her test for the year was likely to surpass any previous one, the highest instance heretofore known being that of the cow Jersey Belle, of Scituate, 7828, owned by Mr. C. O. Ellms, of Scituate, Mass., that made 705 pounds of butter in a year. The accompanying table, compiled from the records kept at Darlington Farm shows the footings for each month and a total result for Eurotas of 778 lb. 1 oz. of butter for the year. No account was kept of the milk and butter made during the first ten days of her milking period, and, as her last calf was dropped a few days within a year from the date of the commencement of the test, she would be entitled to the additional time had the trial commenced five days earlier. The weights of milk and butter were taken at each milking and churning, the butter being weighed before adding the salt, but not until the buttermilk was thoroughly rinsed and worked out. The texture and flavor of the butter are very fine, its color good in summer, but lighter than that of many Jersey cows during the winter months. Enormous as this yield seems when compared with that of an ordinary cow, those who have her in charge express the belief that during the previous year she far exceeded it. This view is sustained by the occasional tests for short periods that were made at intervals throughout the season, which prompted her owner to have her separately tested for a year. Her last calf is a heifer, being the only one she has, the former ones being bulls. It is by Duke of Scituate (No. 3623), a son of Jersey Belle, of Scituate, above mentioned. This bull and a son of Eurotas, called Duke of Darlington (No. 2460), are kept as stock sources at Darlington Farm. A notable feature of the following statement is the richness of the milk in cream, the ratio being but nine and sixty-seven hundredths pounds (less than five quarts) of milk to the pound of butter. The cow is of striking appearance, the development of udder, milk veins, and all the essential apparatus for the assimilation of food and its conversion into milk, being so unusual as to draw the attention of the most ordinary observer.

EUROTAS, 2454.

Dropped calf October 31, 1879, and calved again November 4, 1880. The intervening test for butter commenced with November 10, 1879, and ended with October 15, 1880 (period eleven months six days), at which time she became dry:

Month.	No. of Days.	Weight of Milk.	Weight of Butter. Lb.	Oz.
1879.				
November.........	21	451	40	1
December.........	31	755	74	0
1880.				
January............	31	746	79	2
February..........	29	667½	77	1
March	31	653½	75	6
April	30	602	68	11
May...............	31	770½	87	11
June...............	30	827	88	6
July	31	760½	80	5
August............	31	704	66	7
September........	30	454½	32	5
October...........	15	123½	8	10
Totals.........	341	7,525	778	1

The cow was of course liberally kept, yet the secret of the great yield is clearly in the blood, for it is declared that no ordinary cow, however fed, can be made to accomplish anything like the same results. In winter she had all the hay she wanted, and in addition a pail of gruel of bran and oatmeal thin enough to drink, three times a day. The amount of feed contained in this slop is said to have been slight, and was given rather to induce her to drink freely than to nourish, as grain was found to increase her rapidly in flesh. When grass came, however, to stimulate the lacteal organs, the grain ceased to tend to fat to the same extent, and she was fed three quarts of corn meal daily in two feeds. In hot weather she was stabled from the midday sun, and fed green corn fodder while up, with the choicest of the pasture while turned out. Though hers is said to be the most remarkable test, other cows closely allied to her in blood have made surprising yields of butter.—*Philadelphia Public Ledger.*

INDIAN HENBANE.

By W. DYMOCK.

HENBANE, though a native of the Himalayas, was probably unknown as a medicine to the ancient Hindoo physicians. "Parasika-yamani" and "khorasani-yamani," the names which it bears in some recent Hindoo books, indicate its foreign source. Mohammedan writers call it "banj," an Arabic corruption of the Persian "bang." They say it is the "afeekoon" of the Greeks, the "azmalus" of the Syrians, and the "katfeet or "iskeeras" of the Moors. They also add that in the Deilami dialect it is called "keerchak," because the capsules resemble a little basket with a cover, such as the Arabs make out of date leaves and call "kafeer.' Meer Muhammed Husain's description of "banj" in the "Makhzan-ul-adwiya" agrees well with the genus *Hyoscyamus*. He says there are three kinds—white, black, and red—and that the white is to be preferred. He mentions the preparation of a sun-dried extract from the juice of the fresh leaves, and says that the leaves are also pounded and made into a paste, with flour, out of which small cakes are formed, which, when dry, retain their medicinal properties for some time.

Henbane is described by Eastern writers on materia medica as intoxicating, narcotic, and anodyne. Among the many uses to which it is put the following may be mentioned as peculiar to the East: A poultice of the juice with barley flour is used to relieve the pain of inflammatory swellings; the seeds in wine are applied to gouty enlargements, inflamed breasts, and swelled testicles. About one-half drachm of the seeds with one drachm of poppy seeds are made into a mixture with honey and water and given as an anodyne in cough, gout, etc. Equal parts of the seed and opium are used as a powerful narcotic. A mixture of the powdered seeds with pitch is used to stop hollow teeth which are painful, and also as a pessary in painful affections of the uterus. The juice or a strong infusion of the seeds is dropped into the eye to relieve pain. Ainslie and other European writers upon Indian materia medica notice the use of hyoscyamus seeds in India, and attribute them to *H. niger*, but I have not heard of any one who has raised this plant from the bazaar seed. In the "Mufaridat-i-Nâsari" it is distinctly stated that the officinal article should be the seed of white herbane (bazr-ul-banj-abiad).

Henbane seed is the only part of the plant used in native practice in India; it is known in Hisdostan as "khorasani ajwain," in Bombay as "khorasain own," and in Madras as "khorasain omam."

For the purpose of supplying government hospitals with extract and leaves the *Hyoscyamus niger* has been cultivated at Saharunpore in the Bengal Presidency, at Hoonsoor in Mysore, and at Hewra, near Poonah in the Deccan. The quantity grown is limited to the requirements of government. It is a cold weather crop. If sown in October, the plants will produce ripe seed in March, or even earlier. As regards medicinal qualities, the experience of medical men in India is that the plant cultivated for government yields preparations in every respect equal to those obtained from Europe. Dr. O'Shaughnessy found that three grains of the sun-dried extract produced marked soporific and anodyne effects.

At present henbane leaves are not an article of commerce in India, but the Superintendents of the Government Gardens are, I believe, allowed to grow any profitable crops of medicinal plants for sale. The price charged by the Hewra Gardens to the Medical Department this year for dried leaves is Rs. 1¼ per lb., and for extract Rs. 4 per lb.

The price of the imported seed in the Bombay market is usually Rs. 7 per maund of 37½ lb.—*Pharmaceutical Journal. Bombay, October 15, 1880.*

ARSENIC IN THE BRAIN.

IT is well known that a great quantity of phosphorus is found in the brain, and this phosphorus is contained as phosphoric acid in the lecithine, which is a very complex ammoniacal compound. By experiments with guinea pigs and dogs, Caillot de Poncy and Livron, two French scientists, have recently discovered that, by poisoning those animals with arsenous acid, the phosphorus in the brain is replaced by arsenic, and that the lecithine is changed into an albuminous insoluble substance. In acute cases of poisoning the lecithine which is thus changed has not time enough to take part of the physiological reactions and to become eliminated. The animal, therefore, dies on account of the local effects of the poison and without any great change of the normal quantity of phosphorus in the nervous substance being produced. In cases of chronic poisoning the result is different; the replacement of the phosphorus in the lecithine by arsenic takes place gradually; an arsenous lecithine is produced, which acts like common lecithine, and is finally changed into the albuminous substance, the arsenic slowly decomposing the phosphorus, the quantity of which steadily decreases. It has been ascertained that in some cases eighty-eight per cent. of the phosphoric acid has disappeared, while in cases of acute poisoning only four per cent. has been consumed.—*Réunion Générale des Sociétés Savantes des Départements à la Sorbonne.*

A WEEK'S WORK IN BIRMINGHAM, ENGLAND.

THE following figures are given as representing the weekly output of the factories of Birmingham, England: 15,000,000 pens, 6,000 bedsteads, 7,000 guns, 300,000,000 cut nails, 100,000,000 buttons, 1,000 saddles, 5,000,000 copper coins, 20,000 pairs of spectacles, 6 tons of papier-mache wares, over £30,000 worth of jewelry, 5,000 miles of iron and steel wire, 10 tons of pins, 5 tons of hair-pins and hooks and eyes, 130,000 gross of screws, 500 tons of screw bolts and spikes, 50 tons of iron hinges, 356 miles' length of wax for vestas, 40 tons of refined metal, 40 tons of German silver, 1,000 dozen of fenders, 3,500 bellows, and 800 tons of brass and copper wares.

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